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CONTENTS.

An Asterisk (*) denotes an illustrated article.

OFFICIAL NOTICES—
Second Annual Meeting of the Texas Gas and Electric Light Association..... 645
Nineteenth Annual Meeting, Western Gas Association..... 645

EDITORIALS
Briefly Told..... 646
A Rousing Programme—Two Happier Men—Notes.
On the Recovery of Tar and Ammonia from Blast Furnace Gases, by Mr. A. Gillespie..... 646
*The Protection from Fire Afforded by Corrugated Iron Shutters... 648
The Carbide-Acetylene Patents in England and the Future of Acetylene..... 648
The Fire Hazard of Acetylene..... 650
*Wilkinson's Improvements in the Process of Manufacturing Illuminating Water and Coal Gas..... 650
Arc Lighting Practice..... 651
Safety Appliances for Petroleum Tanks..... 653
A Hypothetical New Hydraulic Cement..... 654
Special English Correspondence..... 655
The Automatic Meter—Who Should Pay for Alteration of Mains, etc.—Acetylene—Prof. Crum Brown on the Composition of Coal Gas and Carbureted Water Gas.
ITEMS OF INTEREST FROM VARIOUS LOCALITIES..... 657
Mr. T. W. Summers Goes to Hornellsville, N. Y.—A Hint from Detroit—Annual Meeting, Rome, N. Y.—Marriage of Mr. Chas. Watson—Cheaper Gas for Chicopee, Mass.—Mr. and Mrs. Christie Sail for Europe—New Holder for the Portsmouth (O.) Company—Executive Management, St. Paul, Minn.—Proposed Gas Company for Jenkintown, Pa.—Mr. Blanchard is Remembered by His Associates—Betterments at Toledo, O.—Annual Meeting, Rochester, N. Y.—Cheaper Gas for Omaha, Neb.—Betterments at Corning, N. Y.—Gas Rates, Decatur, Ills.—Proposed Opposition Company for Montreal—The Whitney Gas Bill, as Reported from Committee—Annual Meeting, Ann Arbor, Mich.—Improvements at Elmira, N. Y.—Death of Mr. C. W. Carpenter—And Other Items.
The Market for Gas Securities..... 659

[OFFICIAL NOTICE.]

Second Annual Meeting of the Texas Gas and Electric Light Association.

OFFICE OF SECRETARY, GONZALES, TEX., March 28, 1896.

The following is a partial list of papers prepared for our second annual meeting, which will be held at Dallas, Tuesday and Wednesday, May 12 and 13, 1896:

"Electric Light Companies and their Consumers," by Mr. L. T. Fuller, of Calvert.

"Fixed and Variable Expenses in Manufacturing Plants," by Mr. Thos. D. Miller, of Dallas.

"Our Association," by Mr. A. E. Judge, of Tyler.

It is understood that Mr. Bauer, of Texarkana, Mr. Cullinane, of Denison, and Mr. Lord, of Fort Worth, will have short papers.

Such papers as are forwarded to the Secretary 20 days before the meeting will be printed (in sheet form) and a copy mailed to each member.

The "Question Box" is open to all, and will be quite a feature.

The question of a "Wrinkle Department" (among other matters) will come up, and it is expected that all who have originated, adapted or adopted some useful method or device will come prepared to tell about it.

The meeting will be called to order promptly at 10 A.M., Tuesday, May 12.

The names of the following gentlemen as Committee of Arrangements, Thos. D. Miller, H. L. Monroe, J. C. Lord, are guarantees that nothing will be left undone for the comfort and convenience of members and visitors. This Committee will make all necessary arrangements as to details of programme for both days, secure headquarters, look after hotel rates, etc.

HOMER W. STARR, Sec'y.

[OFFICIAL NOTICE.]

Nineteenth Annual Meeting, Western Gas Association.

OFFICE OF SECRETARY, NEW ALBANY, IND., April 21, 1896.

The nineteenth annual meeting of the Western Gas Association will be held at Lookout Mountain, near Chattanooga, Tenn., May 20, 21 and 22, 1896, and will be called to order by the President, Mr. A. W. Littleton.

Lookout Inn will be the Association headquarters, and the business sessions will be held in a detached building, closely adjoining the hotel.

The rates at Lookout Inn will be from $2.50 to $4 per day, with a special rate of $2 per day for the wives of the members who may be present.

The Executive Committee met at St. Louis last January, and, as a result, the following papers will be presented for the consideration of the members:

"Self-Education in Gas Engineering," by Mr. Alex. C. Humphreys, New York City.

"Municipalities vs. Gas Companies: Their Reciprocal Relations," by General A. Hickenlooper, Cincinnati, O.

"The Future of the Gas Business," by Mr. M. S. Greenough, Cleveland, O.

"How will the Manufacture of Calcium Carbide Affect the Gas Business?" by Mr. Fred. Bredel, Milwaukee, Wis.

"The (Alleged) Law of Inverse Squares," by Mr. B. E. Chollar, St. Louis, Mo.

"Wrinkle Department," by Mr. Geo. T. Thompson, St. Louis, Mo.

The Southern States' Passenger Association, Trunk Line Association, Central Passenger Committee and Chicago and Ohio River Traffic Associations have granted rates of 1⅓ fare, on the certificate plan for the round trip to Chattanooga. All tickets must be purchased to Chattanooga, from which place Lookout Inn can be reached by electric or steam cars, concerning which more definite information will be given in a future issue of the JOURNAL.

The New England Passenger Association refused the request for reduced rates. All persons in the above territory, or territory not embraced by the Passenger Associations mentioned, will purchase tickets to nearest important station in one of said Associations, and from there purchase a first-class ticket to Chattanooga, paying for same full fare, receiving from the ticket agent a certificate stating that full fare had been paid to Chattanooga, which certificate must be given to the Secretary before the afternoon of Thursday, May 21, so that the Agent of Southern States' Passenger Association may sign certificate, which will entitle the purchaser of ticket to a one-third rate from Chattanooga, returning to the station from which ticket was purchased, providing 100 certificates are presented for signature.

A meeting of the Board of Directors of the Association will be held at Lookout Inn, at 2 P.M., Tuesday, May 19. The following members are Directors: I. C. Baxter, Wm. McDonald, Geo. T. Thompson, Irvin Butterworth, W. M. Eaton, Geo. H. Harper, Peter Young, O. O. Thwing and Wm. Steinwedell.

An invitation is extended to all members of kindred Associations to be present at our meeting and to participate in the proceedings.

The Question Box is ready to receive inquiries, and it is hoped many will avail themselves of the privilege it affords.

The President has appointed the following Committee of Arrangements: Messrs. Jas. Forbes, I. S. Post, Henry Clay Evans and T. H. Payne, of Chattanooga, Tenn.; Robt. Young, Knoxville, Tenn.; E. H. Jenkins, Covington, Ky.; and Jas. T. Lynn, Detroit, Mich.

The undersigned will be pleased to mail blank applications to any who may wish to join the Association and to reply to all communications concerning the meeting. JAMES W. DUNBAR, Sec'y.

BRIEFLY TOLD.

A ROUSING PROGRAMME.—Last week we had occasion to say that the paper list for the current meeting of the Western Gas Association promised to be exceptionally interesting, and this week we have only to point to Secretary Dunbar's second official notice to prove that we knew whereof we spoke. In fact, we feel perfectly safe in declaring that the list is the best one that ever was arranged for the technical portion of the proceedings of any of the American Associations devoted to the conserving of the gas industry. The names of the authors, and the titles of their themes, are guarantees that Mr. Littleton will preside over a meeting that is to be a record one in point of technical interest. Secretary Dunbar has thus far been unable to secure the assent of the Southern States' Passenger Association to grant rates direct to Lookout Mountain, which failure necessitates the purchase of tickets to Chattanooga, but it is not at all unlikely that he will be able to adjust matters so that it will not be necessary to recheck baggage from Chattanooga to Lookout Inn. If he is successful in this bargaining due notice of the fact will be given in the JOURNAL.

TWO HAPPIER MEN.—Both of the men (and men they are in every sense of the word) of whom we are to write have always been noted for their geniality and straightforwardness, and so they were ever happy; but it will be noted that our caption declares they are happier men—and so they are. Why it is they have emerged from the positive to the comparative degree of happiness is best shown by the following simple statement of facts. To begin with, Mr. Walter A. Allen, the clever Superintendent of the Mutual Gas Light Company, of New York, took unto himself a bride, in the person of Mary Amanda, the daughter of Mr. and Mrs. Charles W. Parker, of Kansas City, Mo., on the 14th inst., the services that made them one having been read at the home of the bride's parents. To use the words of a correspondent, who was present at the bridal, in comment on the bride: "Mrs. Allen was formerly a resident of Brooklyn, where, as well as in New York city, she has a host of friends and acquaintances, who will be pleased to regain the star that has temporarily brightened Kansas City's society circles." Mr. and Mrs. Allen will be at home to their friends, after May 15th, at their residence, 244 West 74th street, New York. Handsome Carl D. Bradley, of Chicago, is the "other fellow," who changed for the better the name of charming Emily Jessup, the alteration having been effected in "Greatest Chicago" on the 16th inst. Mr. and Mrs. Bradley will welcome their friends later on to their home in Chicago, at 4259 Grand Boulevard. Both are good men and true, and our wish for them all is that each new day shall bring to them added happiness.

NOTES.—The United Gas Improvement Company has appointed Mr. A. B. Eaton, of Chicago, to act as its Western Sales' Agent, succeeding there Mr. D. J. Collins, who has been called to Philadelphia, to act in connection with the sales' department of the home office. Mr. Eaton is well and favorably known in Western gas circles.——The proprietors of the Otto Gas Engine Works, writing to us from Philadelphia, say: "We desire to advise you that we are informed by our counsel, Messrs. Baldwin, Davidson & Wight, of Washington and New York, that the electrical igniter on the gas and gasoline engines, made by the New Era Iron Works Company, is an infringement of U. S. Letters Patent, No. 525,828, granted to Mr. Paul A. N. Winand, of which we are the owners. We have brought suit in the Southern District of Ohio against the New Era Iron Works Company, and propose to protect our rights against all makers and sellers or users of engines having upon them igniters covered by such Letters Patent."——At the annual meeting of the Belvidere (Ills.) Gas Light and Fuel Company the officers chosen were: Directors, Jno. L. Witbeck, Jno. H. Witbeck, Geo. H. Hurlbut, W. L. Longcor and F. B. Rowan; President, F. B. Rowan; Secretary, P. R. Kennedy; Treasurer, Irving Terwilliger. The only change in the executive management is the substitution of Mr. Kennedy for Mr. Longcor in the place of Secretary, Mr. Longcor's other interests being of a nature to prevent him from giving to the Belvidere Company that close attention which its growing business demands.

On the Recovery of Tar and Ammonia from Blast Furnace Gases.

By Mr. A. GILLESPIE, of Glasgow, Scotland.

Though coal tar as a distillate from coal was known for more than a century before 1798—having made its appearance in connection with various attempts to produce coke for smelting purposes—it was not until about that time, when William Murdoch made his discovery of illuminating gas from the destructive distillation of coal, that tar as a product was made in such quantities as to demand separate attention. At first it was got rid of as a "nuisance," and ultimately it was found to have such distinct values of its own as to remove from it the reproach of bye-product, and bring it into line with original processes. As to the "nuisance," it may be said that within living memory it seemed practically impossible to get rid of the tar; and as to value, coal tar now counts upwards of 50 constituents of separate commercial importance.

As this fact came to be realized, together with the growing necessity for economizing fuel, attention was directed to the waste of the gases seen burning at the top of blast furnaces. Until comparatively recent years it was considered that the coal charged into a blast furnace had done its whole work when the ore was smelted and the liberated iron run into "pigs," the air of the hot blast being heated by additional coal in a separate stove. The first step in the utilization of the waste gases was in closing the furnace tops, and passing the gases so confined by a system of piping to the boilers for supplying steam to the blowing engines and to the air stoves for heating the blast. This was a clear saving of all the coal outside the furnaces. The next step was taken when it became evident that the tar which revealed itself in the "green" gas coming from the closed furnace top, causing trouble and discomfort in the combustion of the gases, might be turned to advantage, as had been done in the production of illuminating gas.

The initial difficulty in the treatment of such gases lies in their enormous volume. The quantity of gas obtained from a ton of coal distilled in ordinary retorts for illuminating purposes is about 10,000 cubic feet; while from the presence of the air-blast mixing with the coal gas distilled in the process of smelting the volume is increased to about 130,000 cubic feet, or 13 times the quantity of illuminating gas. The valuable bye-products which come from the coal alone are thus diffused through the entire volume; while to recover them it is necessary to deal with the whole. To give some concrete comparison of such a large volume, it may be stated that the greatest output of gas from the whole of the Corporation gas works in the Glasgow district is less than 30 million cubic feet per 24 hours, while the volume coming from four blast furnaces is upwards of 40 million cubic feet, requiring a collecting main having a diameter of 8 feet.

Next in order is the difficulty which is involved in the high heat of the gases that pass by the collecting main to the recovery plant; the temperature being about 300° F., which must be reduced to less than 70° before ammonia can be properly recovered—the tar being in the meantime obtained in the process between those limits of temperature. It thus becomes apparent that the apparatus must be on a very large scale, while the difficulty and expense are increased by the fact that the combined gases form an approximately explosive mixture—rendering it necessary to make ample provision against possible danger.

The first attempt to recover the tar and ammonia from blast furnace gases was carried out about 16 years ago by Messrs. McCosh and Alexander, of the Gartsherrie Iron Works, and known as the Gartsherrie process. Other methods followed, all more or less based on the ordinary process of removing the tar and ammonia from illuminating gas (differing chiefly in dimensions); and now nearly all the active blast furnaces in Scotland have been furnished with a recovery plant of one form or another. As yet scarcely any of the iron smelting furnaces in England are so equipped, the smelting done in them being chiefly effected by coke, instead of by raw coal. In a few cases the products have been extracted from the ovens in which coke is prepared; but, as a rule, the product-bearing gases are neglected and lost by combustion in the coke oven.

It might be supposed that, while the recovery of the ammonia from the blast furnace gas does not reduce the calorific value, the extraction of the tar compounds would have such a result. But practically this has not been found to be the case, for the clean gas after the recovery process is in better condition for burning under the steam boilers and in the hot air stoves than when it was laden with tar and dust; and it is clearly proved that from the same coal charged into the furnace, or, more accurately, from the surplus gases generated from the coal in combustion, is derived heat energy sufficient to drive the blowing en-

gines and heat the air of the blast to 1,700° F., plus the oil, the pitch, and the sulphate of ammonia obtained in the recovery plant. To put this again into concrete form, it may be stated that the results obtained from a plant recently erected in connection with four furnaces show that, in addition to the usual output of pig iron, the clean gas raises steam in 17 large high-pressure boilers, heats the air in three regenerative stoves, distils the tar into oil and pitch, and evaporates the waste liquor; while the recovered tar yields 7 gallons of oil and 86 pounds of pitch, and the ammoniacal liquor 25½ pounds of sulphate of ammonia per ton of coal put into the furnaces. The total recovery for 1895 from 92,940 tons of coal carbonized in the four furnaces amounted to 677,000 gallons of oil, 3,550 tons of pitch, and 1,057 tons of sulphate.

As we are not concerned with the gases in combustion in the "boshes" or hottest part of the blast furnace, where the ore is being reduced, but with those from between the "burden" of raw coal and iron ore and the closed top, which we may term the surplus or "green" gases, these, prevented from access to the air and consequent ignition, pass by the open valve of the down-comer tube from each furnace to the collecting main. The green gas is drawn through this main by exhausters placed farther on in the plant, and the high temperature is conserved as far as possible by a firebrick lining inside the main. It then enters the first vessel in the process—the "tar washer"—which is a large oblong-shaped tank having the bottom ridged and sloping to each end. Internally there are two compartments which are formed by longitudinal partitions to give a double wash. These partitions are fitted with serpentine diaphragms having serrated edges. When in operation, the compartments are charged with tar till it rises above, or seals, the edges of the diaphragms, thus rendering it impossible for the gas to pass except by washing through the tar. The gas is drawn through the seal by the power of the vacuum which is formed by the exhausters, and the entire area is continuously agitated with a double result. First, the hot gases partially distil the water out of the tar; secondly, the contact with the tar in the washer entangles the tar particles in the gas, and precipitates them on the sloping bottom, whence the heavier tars are run off at intervals to the stock tank. Along with the heavier tars, the gas has lost in this washer about 130° of its heat, and is ready for the final cooling in the "condenser." This vessel is divided into 8 sections, each having a separate chest fitted with 18 pairs of pipes which are 20 inches in diameter and 54 feet high. An arrangement is made in the chest so that the gas passes up one pair and down the next continuously, till by the time it reaches the final pair its exposure to the atmosphere reduces the temperature to 70° and less. In warm weather it is necessary to supplement this cooling by a spray of water on the top of each pipe. The water runs down the outer surface, both reducing and equalizing the temperature.

The lighter tars and weak ammoniacal liquor which are separated from the gas in condensing are collected from each section and pass into a "separator," where, by the difference in their specific gravities, the tar and liquor are automatically separated. The gas now passes by double branches into the first "liquor washer." This is a vessel 60 feet long, 12 feet 6 inches wide, and 7 feet high. It is fitted internally with a longitudinal partition and serpentine diaphragms, similar to those of the tar washer, but with a wider single action. They are sealed in weak liquor, and the gas, now at a temperature of about 60°, is again drawn through the seal by the exhausters—the diaphragms dividing the gas into thin streams. In the continuous agitation caused by the displacement, the light tars are washed out, and the ammonia is taken up by the liquor. The products pass by a regulating valve into another separator; while the liquor, at a strength of 1¼° Twaddell, is run into a stock tank for treatment in the sulphate stills, and the light tar to feed the tar washer.

Next in order in the process come the exhausters, which are of various forms. There are three of the ordinary Root's blower type, each capable of passing 900,000 cubic feet of gas per hour. As the effective washing of the gas depends on the depth of seal in the washer, the vacuum necessary to draw the gas forward is regulated for each vessel by tubes connected from them to gauges placed in the exhauster house, so that the attendant may control the speed as required.

The second and final liquor washer is placed beyond the exhausters, and is the same in all respects as the first, except that the gas is forced through the seal, and the vessel is fed with clean cold water. In this washer the last traces of tar and ammonia are received, and the gas is cleaned ready for use at the boilers and air stoves, to which it passes in a pipe having a diameter of 5 feet. The products—consisting of weak ammoniacal liquor, of about 0.5° Twaddell strength, and light frothy tar—are again separated, the liquor returned to feed the first liquor washer, and the tar as before to the tar washer.

In the further treatment of the recovered products, the heavy tars, run periodically from the bottom of the tar washer into the underground stock tank, are run as required into blowers, and delivered by compressed air into an elevated charging tank near the tar stills, into which the tar gravitates for distillation. These stills are wagon-shaped boilers formed with double flue recesses on the bottom, and fired by the clean gas. Each still is supplied with a worm condenser placed in a cold water tank.

When a still is charged, and the gas turned on and ignited, the first portion of the distillate is water. The tar as at first recovered from the furnace carries about 80 per cent. of water; but this has been reduced, as has been seen, by exposure to the hot gases in the tar washer. When the water has been driven off, a light oil begins to appear, getting heavier as the distillate approaches the pitch stage. The distillate running from the worm passes into a separator, and the water, containing traces of ammonia, is cooled and sent back to feed the first liquor washer, while the oil passes into the blowers, from which it is delivered, by compressed air, into the oil stock tank, or into barrels for immediate sale. When the still is ready for "pitching," the worm is shut off, and the liquid pitch run first into a cylindrical cooler, and afterwards into open ponds, to harden solid, and is then broken up, packed and despatched.

The ammoniacal liquor stored in the liquor division of the stock tank is run into blowers and delivered into an elevated tank, as described for the tar, whence it gravitates continuously into the sulphate stills. In the sulphate house there are two vertical cylindrical stills, each fitted internally with 11 horizontal trays, having open nozzles projecting upwards, placed as close together as possible, and each nozzle covered by a loose cap having serrated edges. The ammoniacal liquor is run in upon the top tray, filling all the space round the nozzles, and sealing the cups. It is compelled, by means of a baffle plate, to circulate round the nozzles, while at a certain level it runs off by a pipe to the next lower tray—the process being repeated from tray to tray till the bottom is reached. At that point, steam is introduced under the bottom tray, and, passing up by the open nozzles, it bubbles out through the serrations of the cups; and the steam, ascending through the nozzles from tray to tray, meets the descending liquor, and, by the inducement of greater affinity, robs it of its ammonia—carrying it off at the top in the form of ammoniacal vapors. These are conveyed by a system of piping into the saturator—a lead lined vessel charged with sulphuric acid. The vapors are taken right to the bottom through a lead "cracker" pipe, which is perforated with small holes through which the vapors pass and combine with the acid, forming sulphate of ammonia, which contains 24 per cent. of pure ammonia. After boiling for some time, crystals of the salt are precipitated in the bottom of the saturator, from which they are fished out by hand ladles or mechanical dischargers, placed in skips over a draining table, and, when dry, conveyed by an overhead rail to the sulphate store for packing and despatch.

So far, we have been recovering salable products from what was formerly "waste and nuisance." But it cannot be said we have entirely removed the waste or the nuisance. The waste or surplus gas not required for any heating purpose is automatically passed into the atmosphere when the quantity exceeds the pressure required, the escaping gas being burned as it passes into the air. The waste vapors coming from the saturator may be condensed and purified before passing into the air, or destroyed in the still flues and chimney. But the waste or effluent liquor coming from the sulphate still is not so easily got rid of, and the efforts to dispose of it remind one of the tar nuisance of former days. Even after filtration, it is not safe to run into a stream. It seems to be fatal to fish; at least they do not thrive on it.

At the works referred to in this paper, the form of still adopted removes nearly all the solid from the liquor. The stills, which are fitted with appliances for ease and rapidity in cleaning, are opened at intervals, and the cups and nozzles are cleaned of the pitch deposit; while the liquor as it leaves the bottom of the still passes into a large settling tank, through which the current travels slowly against baffle plates—throwing down any solids contained in the liquor. The clean liquor is then run off hot from the top of the tank to feed the steam boilers, where the larger proportion is evaporated in raising steam, and the remainder drawn off from the boilers into a special evaporating pan or furnace, where any solid material still remaining is burned down to ash, yielding on further treatment a small proportion of potash.

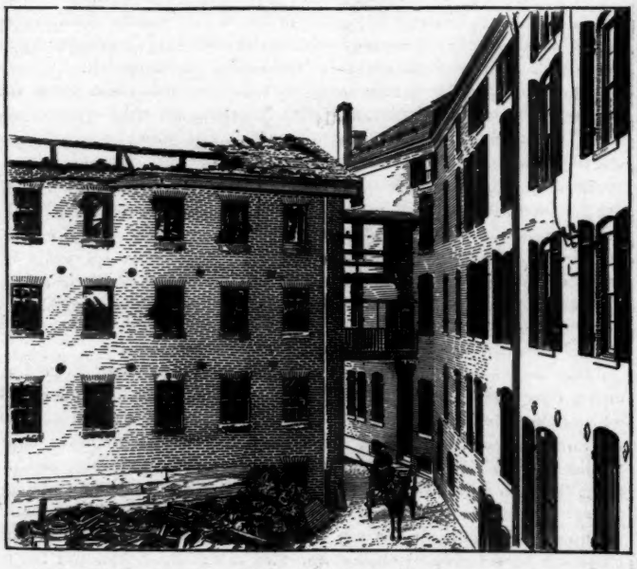
It is not the province of this paper to follow the various products recovered in the process, and their ultimate uses and effects in the industrial arts; but these are not without interest. The pitch oil is extensively used for lighting in factories and large areas by the medium of "Lucigen," "Wells," and other lamps and torches, and for enrich-

ing poor coal gas. It is also employed as fuel in steam boilers and furnaces. The pitch is utilized in many ways. In a thoroughly equipped colliery the coals are washed and screened to various sizes, till the ultimate dust is carried off in the washing as mud, which is subsequently dried, steamed and mixed with a portion of the pitch, and moulded by machines into briquettes. The pitch is also used in all the appliances of asphalt for paving, and for roofing and felting. The commercial sulphate of ammonia, besides its numerous chemical applications, is now extensively used as a manure, and holds a first place as a fertilizing agent. When added to the soil, it readily imparts to it the nitrogen necessary for absorption and assimilation by the roots of plants. It is most widely used in the production of beetroot, and as a top and second dressing on grass lands, and generally for the stimulation of all forms of plant life.

It has been said that the world owes much to the man who can make two blades of grass grow where but one grew before; and though hard things have been said about the desolating of the "coal and iron seeker" in the havoc which he has wrought on the earth's surface, still we have seen how even he has done something to bring back a smile to that fair face of Nature which he has done so much to scar and defile. He may have done all this for selfish ends, as something to compensate him for the low price of pig iron. But he has paid a debt to Nature in practising economy instead of waste of her forces, and fulfilled a duty to society which might be imitated by other coal users on land and sea; for he has taken full use of his coal gases, and his chimneys are now restricted to their primary use—that of creating a draught, and not for creating an intolerable nuisance.

The Protection from Fire Afforded by Corrugated Iron Shutters.

Protecting buildings and property from fire arising in adjacent buildings is a problem which has engaged the attention of architects and engineers for a number of years. To light the interior of any building over one story in height, windows must be provided, and when buildings stand in close proximity to each other it is necessary to protect the openings in order to prevent fire from communicating between. What constitutes the best protection under these circumstances is a question not easily decided, but we wish to call the attention of our readers to a case which has lately come under our notice in which it would seem that corrugated iron shutters, when properly made and properly fitted, are a decided protection against the spreading of fire.



The illustration shown herewith is sketched from the ruins of a fire in the large manufacturing plant of the Russell & Erwin Mfg. Company, at New Britain, Conn. The building shown on the left was completely destroyed, the interior being entirely burned out. The structure on the right is one of the main buildings, six stories in height, and had the fire communicated with that the entire plant would have been destroyed. The openings, as shown in the illustration, were protected by the Berlin Iron Bridge Company's corrugated iron doors and shutters, which are nightly closed by the watchman. The heat from the burning building was very intense, yet, owing to the window openings on the adjacent building being protected with these corrugated iron shutters, no fire communicated across the opening, which was but 15 feet in width, and the entire plant, costing millions of dollars, was saved from destruction. The heat was so intense that any ordinary wooden shutter covered with tin would have been entirely destroyed, and a flat iron shutter would have been warped so to have been no protection. As it is seldom that so practical a test of fireproof shutters is made, we thought it advisable to call the attention of our readers to the circumstances.

The Carbide-Acetylene Patents in England, and the Future of Acetylene.

[An interview between Prof. Lewes and a representative of the *Gas World*.]

The refusal of the House of Lords' Committee to antedate Mr. T. L. Willson's patents for the manufacture of calcium carbide and the production of acetylene gas has aroused considerable interest in gas circles, an interest which has not been altogether satisfied by the rather vague pronouncement of Messrs. Mewburn and Ellis, Mr. Willson's patent agents, which appeared in last week's *Gas World*, that "the production of calcium carbide is not altogether dependent upon the particular patent referred to, and even that particular patent has a good deal of life in it." When in doubt about anything concerning acetylene, perhaps the best thing to do is to ask Professor Vivian B. Lewes, who was the first to introduce the gas to this country as something more than a laboratory plaything. Accordingly, a representative of the *Gas World*, hied him to the Professor, whom he found at an opportune moment, busily testing an acetylene flame which would have been pleasant to look at had it not been that it was of a 180-candle power. Even the interviewer cannot face a reception like that without blinking, and if he could he would find that a man looking at a photometer disc is proof against all his blandishments. Once away from the testing room Professor Lewes was found more approachable, with the result that the *Gas World* representative had quite an enjoyable talk with him about the newest of new illuminants.

Plunging into the business that had brought us there we asked: "You have seen Messrs. Mewburn and Ellis' letter in last week's *Gas World*, Professor, suggesting that despite the rejection of Willson's Bill by the House of Lords' Committee, the manufacture of calcic carbide is not open to the public?" "Yes," he replied, "I have seen it, and I think the statement is quite correct. There is no doubt in my mind, and never has been, that the factor that will govern the production of calcic carbide is the electrical furnace patents and not the patents of either Bullier or Willson; and the electrical furnace patents (the Cowles patents, which I consider master patents) are, in this country, the property of the British Aluminum Company, Limited."

"But any one can get a license to use those patents for the manufacture of carbide?" "The right to use those patents in the manufacture of calcic carbide has been acquired by the Acetylene Illuminating Company, Limited, of 63 Queen Victoria street. The sole rights for the United Kingdom have been secured by that Company, and I certainly think that places them in an extremely strong position."

"Apart from patent rights, whom do you consider to be the inventor of this process of manufacturing carbide?" "I think Willson discovered how to produce calcic carbide commercially by means of the electrical furnace. My reason for thinking that is that I have proof that in 1892 Willson sent samples of calcic carbide made by this process to Lord Kelvin, from whom he holds a letter dated October, 1892, acknowledging receipt of the substance and commenting upon it."

"At that time did Willson know that the carbide could be used for the production of acetylene?" "He knew perfectly well that it could be so used, but it did not occur to him that it was a thing of any great commercial value, so that it was not until a later date that he applied for his American patent. Then, on the 5th March, 1894, M. Moissan read a paper, reported in the 'Comptes Rendus,' describing the manufacture of calcic carbide in the electrical furnace. That was subsequent to Willson's application for an American patent, but earlier than his application in England, which, unfortunately, was made on the wrong form. By the time that mistake was discovered it was too late to rectify it by anything short of an Act of Parliament, the result being the Bill which was rejected by the House of Lords' Committee last month."

"Can there be any doubt that the publication in the 'Comptes Rendus' invalidates Willson's patents?" "It undoubtedly invalidates

them. Bullier, who, I believe, is one of Moissan's assistants, applied for a patent in England nearly a year after Willson, and, of course, the publication in the 'Comptes Rendus' invalidates that also. Will you allow me to explain that when I read my paper* before the Society of Arts at the beginning of 1895, I made no mention of M. Moissan's work on calcic carbide. I see that in a recent publication M. Moissan has expressed surprise at that, but the truth is at that time I was not aware that he had been working on the subject, not having then seen the communication in the 'Comptes Rendus.' All the figures given in my paper were worked out independently in my own laboratory."

"You have been working on this subject ever since your Society of Arts paper?" "I have been working steadily on the methods of producing the carbide and studying the properties and the best methods of burning the acetylene."

"Can you say anything definite as to the cost of the carbide?" "The question of cost seems to be as open as it was when I read my paper. Large companies have been floated in America and on the Continent, but the statements made as to the cost are still of the most varied kind. One of the most prominent scientific men connected with the matter—M. Raoul Pictet—does not hesitate to place his cost as under 100 francs per ton of 1,000 kilos; but I must confess that that is not confirmed by my own experiments."

"Can you say what the cost would be in this country, with the manufacture carried on under ordinary conditions?" "I have never made more than half a pound of carbide per electrical horse power per hour; but with improvements in plant and continuous working that might be increased to one pound. In the best electric lighting installations, working as they do with variable load, the cost of the electrical horse power has certainly not been reduced below 3 cents per hour, but if a constant load were obtained, by making carbide when not employed in lighting, that figure would probably be reduced below 2 cents. Even taking the best conditions, and granting that one pound could be made per electrical horse power, that, with material, would bring the cost of the carbide to between $55 and $60 per ton."

"Is it to be understood that you favor the manufacture of the carbide by the electric lighting companies, in preference to manufacture at special works?" "Were the manufacture taken up by the electric lighting companies, I think it would be an enormous advantage to those interested in the production of acetylene, and also give a great impetus to electric lighting, by reducing its cost."

"But do you suggest that the carbide should not be made at special works at all?" "I think the demand for acetylene will be so great that to produce the necessary carbide central installations will be required to supplement the existing electric lighting works."

"You evidently have great hopes for acetylene?" "I am of opinion that acetylene has a great future before it; but it will not injure either gas lighting or electric lighting, for it will find its field where neither of these exists—in the lighting of country mansions and institutions, and in small country villages, where gas works are out of the question."

"How do you propose to manufacture the gas for use in these places?" "It will be manufactured by the decomposition of the carbide by water in simple forms of apparatus. But I do not think that any of the automatic forms of apparatus now being introduced are in any way suited to the purpose. They are all based on the idea that by cutting off the supply of water to the carbide you stop the generation of gas; but that is not the case. If you take a small automatic arrangement of that character, fitted, as is usually the case, with a 5 or 10 cubic feet holder, the rise of which at a certain point cuts off the supply of water to the carbide, you find that gas is generated for a very considerable period after the water has been cut off. That is due to the fact that the great heat developed by the decomposition of the carbide has vaporized some of the water previously supplied, and that vapor condenses and acts upon the carbide; also, the slaked lime in the apparatus is dehydrated by carbide that has not been acted upon, producing more gas. So long as such an apparatus is supplying a number of burners, the slowing down of production by cutting off the water enables the consumption to overtake the production; but when all the burners are shut off the slow generation of gas either causes the holder to blow or produces dangerously high pressures in the apparatus. Undoubtedly the proper way to utilize the gas is to have a holder of sufficient size for the evening's supply, and to fill that from an ordinary generating apparatus."

"Then you have abandoned the idea of portable lamps, which you mentioned in your Society of Arts paper?" "Further experience has shown me that it is not possible to cast the carbide into sticks, and that the pressures generated in such lamps are beyond the limits of safety for domestic purposes."

"You have spoken about the danger of high pressures; what about the dangers of explosion and poisoning?" "The dangers of acetylene have undoubtedly been very much overrated. That is made perfectly clear by recent researches, which show that acetylene is less poisonous than ordinary coal gas, and far less poisonous than coal gas enriched with carbureted water gas; so that that part of the question may at once be dismissed. As to the danger of explosion, the fact that acetylene can be decomposed by detonation has given rise to the idea that it must be looked upon as an explosive apart from any admixture with it of air. But that is a mistake. If you fire a heavy charge of mercuric fulminate in acetylene the explosive wave is only propagated for a short distance in the gas and then ceases. In practice the only detonation that could take place would be due to explosion of acetylide of copper, formed by the action of the gas on copper or brass fittings, and experiments have shown that that will not cause the detonation of acetylene."

Has the gas any action upon other metals?" "When dry and pure it has practically no action upon metals, but when moist it acts rapidly on copper and more slowly on copper alloys. It is, therefore, better to exclude brass and alloys of the same character from fittings to be used with the gas."

"Has a burner been devised that will burn the gas satisfactorily?" "The great obstacle to the introduction of the gas at the present moment is that there is no burner that will act satisfactorily with it. Many nipples have been made, both in England and on the Continent, but I think I may claim that the one I have designed myself has given the most general satisfaction. Yet even that is liable to smoke after having been in use for from 30 to 50 hours; which is due, I think, to the heat of the burner causing some of the acetylene to polymerize into liquid and even solid hydrocarbons, which get carbonized in and around the fine apertures of the burner."

"Then the real difficulty is the burner?" The real difficulty in introducing acetylene at present is the want of a proper burner, and also that, despite all the work that has been done, there are still several points which have to be cleared up before it will be absolutely safe to introduce it for domestic purposes. I am strongly of opinion that those who are introducing automatic and other generators are incurring a great responsibility to the public. The subject is being thoroughly thrashed out scientifically, and when the doubtful points have been made clear, then the gas will be brought forward for public use. These premature efforts will only lead to expense and disaster, and will greatly retard the proper utilization of the gas."

"Do you still say that the illuminating power is 240 candles?" "The illuminating power is undoubtedly 240 candles; I should be inclined rather to raise the figure than to lower it. But it must be clearly borne in mind that it is with acetylene as it is with every other illuminating gas, the illuminating power depends upon its being burned under proper conditions and in sufficiently large quantity. The value of 240 candles is obtained only when the gas is burned at the highest practical rate."

"What do you say about the proposal to burn the acetylene mixed with air, carbon dioxide, or other diluent?" "If you mix acetylene with diluents such as hydrogen, carbon monoxide, water gas, nitrogen, or carbon dioxide, there is an enormous loss of illuminating power, if the diluent is used in large quantity, but any of these can be used in quantities up to 25 per cent. without seriously affecting the illuminating power."

"But there would be no advantage in doing so?" "The only advantoge would be that it would be easier to get a burner that would consume the gas without smoking. Of the diluents named hydrogen is the best and carbon dioxide is the worst. But the idea of taking any gas and adding acetylene to it so as to make a 16 or 20-candle gas is commercially impracticable, because it would take something like 25 per cent. of acetylene with even so good a diluent as hydrogen to give that result."

"Then after a proper burner has been found and those little difficulties you have hinted at have been overcome, you think acetylene has a great future before it?" "Undoubtedly so. It will be very suitable for lighting railway carriages, tramcars, and country houses; but I do not feel inclined to claim for it the universal employment that has been spoken of in connection with the formation of some of the companies. Railway carriage lighting is one of the most promising fields, for there it can be used in exactly the same way as oil gas is now used; that is, carried in cylinders at a moderate pressure. I do not think that the railway companies will permit its use in the liquid form. For

* See JOURNAL February 4 and 11, 1895.

safety I am strongly of opinion that the cylinders should be filled from a holder, by pumping in the ordinary way, and not by the pressure in the generating vessel; for if you add, as you would do in the latter case, the heat of formation to the heat of compression, trouble will be caused; some of the acetylene will be polymerized into tar-like products which will block the pipes."

As a parting bit of information, Professor Lewes told us that the safety of the gas depends largely upon the purity of the materials used in its production. The carbide should be made from lime free from phosphates and sulphates, and the carbon should be good powdered metallurgical coke. If phosphide is present it is converted into phosphoreted hydrogen on the addition of water, and, of course, phosphoreted hydrogen is a very dangerous thing to have about. There is nearly always trace of gypsum in the lime and of sulphur in the coke, and, of course, these yield sulphureted hydrogen; but as slaked lime is a bye-product from the manufacture of the acetylene the removal of the sulphureted hydrogen is easy.

The Fire Hazard of Acetylene.

The *Am. Exch. and Review* says that the fire risks of the use of the calcium acetylene illuminant remain at the undeterminable stages. It would be well to start the investigation with the assumption that any use of acetylene is not half the jeopardy of the iron still in petroleum refinement, though it may be said that acetylene is some addition to the benzine risk. Some products of the different conversions of crude petroleum into gas may be chiefly acetylene, and the carbide of calcium acetylene is a gain in the conversion of the caloric energy into light rather than flame through the influence of the calcium. It appears that after a consultation of the New York Board of Fire Underwriters with Professor Morton, of the Stevens Institute, the non-acceptance of the risks in buildings where certain acetylene gas machines should be used was decided upon. This involves the question of the construction of the plants. No action was taken with regard to the use of the gas when supplied through mains. By newspaper report the Wisconsin State Board of Fire Underwriters is made to appear ridiculous by placing acetylene "under a ban" because the fire insurance companies of the country regarded such gas as dangerous as gasoline. Yes, the acetylene is dangerous, fire-wise, so is steam as a motive power, and machinery, to say nothing of electricity, and fire insurance exists because fire danger exists, and fire is an increasing danger. The fire underwriter is to deal with the danger of acetylene according to its degree, or, rather, its degrees. Early in the thirties of this century the Fire Underwriters of the United States decided by concurrent individual action not to vary rates by reason of the introduction of the carbureted hydrogen gas as an illuminant—the evidence not substantiating a measurable increase of hazard (Fowler's History of Insurance, pages 353, 354, 355), though there was much apprehension to the contrary, and such apprehension was backed up by chemical theories not resting upon thermotic knowledge. Acetylene is, however, akin to the petroleum fire jeopardy, like petroleum it adds nothing to spontaneous ignition excepting as there may be special contribution thereto by hydrogen. We would, however, dismiss all conjecture as to the carbon being associated with phosphoreted hydrogen in acetylene, as the phosphorus seems to be got from nowhere.

The specialty of the acetylene as fire hazard is as the maker of fires by explosions, it being of great molecular energy. It ignites at a lower temperature than present illuminating gas, but then it requires 896° F. in order to ignite, and at such temperature pine wood will begin to flame. Admitting that the acetylene light is largely phosphorescent, but using this term as denoting simply emission of light without heat, and as not necessarily involving phosphorus, the proposition of the American Exchange and Review is that the acetylene light is a hydrocarbon lime light, whatever fire relations that may comprehend under all the conditions of manufacture, supply and use, and you can put all possible jeopardy between $\frac{5}{1000}$ and $\frac{1}{100}$.

The acetylene explosion which took place January 1 at New Haven was caused, according to the finding of the inquest upon the bodies of the victims, by a rupture of the pressure-reducing valve, happening in the course of the experiments then making, by a machinist using a 30-inch wrench upon it. This allowed the gas to escape, and the gas, attaining explosive proportion of mixture with air, and becoming ignited, the explosion, fire and fatality resulted.

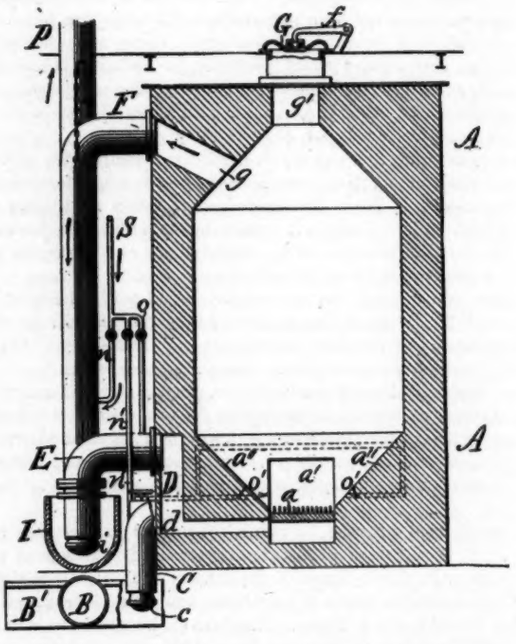
Now, March 29, the so styled "original acetylene works" burn. We referred in the March Review ("The Calcium Acetylene") to the somewhat accidental production of carbide of calcium and the evolvement therefrom of acetylene at the aluminum works in North Carolina (Spray, Rockingham county), burning March 29, which began the manufacture of the *calcium* acetylene. Regarding the works before the fire as of the hazard, $\frac{1}{100}$, it would take 100 of such works 25 years to burn 100 in value, with replacement of them as burning, flaming say in the following annual succession in the first eight years as example, 2, 4, 6, 4, 1, 5, 2, 8, which is somewhat suggestive of a less ignitive rate and higher combustive rate than the Philadelphia cotton woolen mill, but which one of these two classes of risks will outburn the other we cannot say.

Wilkinson's Improvements in the Process of Manufacturing Illuminating Water and Coal Gas.

On March 24th U. S. Letters Patent (Nos. 556,910 and 556,911) were granted to Prof. A. W. Wilkinson, of this city, for improvements in the process of manufacturing illuminating gas, having reference to the use of carbide of calcium in such processes. No. 556,910 relates to the use of the carbide in the manufacture of water gas. Using the words of the specification:

This invention relates to a new and improved process of manufacturing illuminating water gas from hard or anthracite coal and carbide of calcium by the aid of steam.

The object of my invention is to provide for manufacturing illuminating water gas containing a large percentage of olefiant gas directly in a cupola gas generator.



In carrying out my invention I use a cupola gas generator such as is used in the manufacture of water gas, a suitable form of which is illustrated in the accompanying drawing, which represents a cupola in vertical section and suitable connecting pipes in elevation.

The cupola *A* is preferably constructed with an iron jacket and a lining of firebrick, and has an inclined bottom *a''*, a grate *a*, and ash door *a'*, and is constructed at the top with a fuel opening *g'* and a gas escape opening *g*. A suitable mouthpiece, having a lid *G* connecting to a pivoted lever *f*, is secured to the top of the cupola at the opening *g'*. A chamber *D* and a blast port *d* are formed in the brickwork at the base, said port leading into the ashpit below the grate. An air pipe *C*, leading from the air blast box *B'*, connects with the chamber *D*. An air blast pipe *B* admits air from a blower (not shown) to box *B'*. Pipe *C* is provided at its lower end with a conical valve *c*, which may be controlled in any suitable manner. A gas take-off pipe *E* leads from chamber *D* into the hydraulic main *I*, where its lower end is provided with a conical valve *i*. A gas take-off pipe *F* connects with the top of the cupola at passage *g* and extends down into the main *I*.

The main steam supply *S* connects by the branch *n* with the gas take-off pipe *F* for conducting steam into the top of the cupola. The branch pipe *n'* connects with the superheating and discharge pipe *o'* in the

brickwork just above the grate, and the branch pipe *o* connects with the gas take-off pipe *E*. These pipes are provided with valves for controlling the flow of steam into the base or top of the cupola. The pipe *P* leads from the hydraulic main for conducting gas to a holder or other place of use.

The apparatus is operated as follows: A fire is kindled on the grate in the usual manner and the cupola is filled to the desired height with a mixture of hard coal and from 1 to 10 per cent. of carbide of calcium, the percentage depending upon the candle power of gas required. An air blast is admitted until the body of coal is heated to incandescence, when the air blast is shut off and the lid *G* at the top of the cupola is tightly closed and gas take-off pipe *F* is opened. Steam is now admitted into the base of the cupola and is decomposed as it passes up through the incandescent coal, producing carbonic oxide and hydrogen, and at the same time another portion of the steam united with the carbide of calcium, liberating acetylene. This acetylene gas, as liberated under favorable conditions, will unite with the nascent hydrogen, forming olefiant gas. The decomposition of steam and formation of olefiant gas are continued for about 10 minutes, or until the temperature of the coal is reduced too low for effectively decomposing steam, when the steam is shut off and the air blast is again admitted for heating the coal to incandescence. By the addition of coal and carbide of calcium from time to time the process may be conducted as long as desired.

The result of the operation is the production of a mixture of gases which possesses great illuminating power and burns with great brilliancy. With care in the manufacture little or no purification of the gas is required, just simply cooling, when it is ready for storage in the holder.

Having described my invention, what I claim, and desire to secure by Letters Patent is:

1. The within described process of making illuminating gas from the decomposition of steam by red hot coal and the liberation of acetylene by steam from the carbide of calcium in a cupola.

2. The process of manufacturing illuminating water gas which consists in heating a body of coal and carbide of calcium to incandescence by an air blast, then shutting off the air and passing steam, in contact with the incandescent coal and carbide of calcium, thereby liberating acetylene and nascent hydrogen to form olefiant gas.

The words of the other specification, connected with Letters Patent No. 556,911, are:

This invention relates to the manufacture of illuminating gas composed principally of olefiant gas.

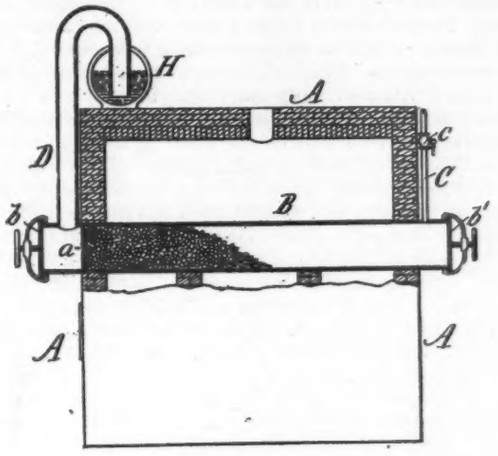
The object of my invention is to increase the yield and candle power of gas generated from a charge in a coal gas retort and to obtain a product composed principally of olefiant gas.

In carrying out my improved process of manufacturing illuminating gas I add to the ordinary charge of bituminous coal a suitable percentage, according to the candle power required, of carbide of calcium, introduce the mixture into the ordinary coal gas retorts and distill in the usual manner. The coal usually contains a sufficient amount of water to liberate all the acetylene that the carbide of calcium is capable of generating. If there should not be a sufficient amount of water in the coal, the mouthpiece of the retort is fitted with a steam pipe for allowing a certain amount of steam to enter at the end of the distillation to discharge the last traces of acetylene from the carbide of calcium.

I have found that during the process of liberating gas from the coal and carbide of calcium there is formed olefiant gas. The nascent hydrogen coming in contact with the acetylene, a reaction takes place, producing olefiant gas, a gas more desirable as an enricher than acetylene. At the same time the volume of the gas is greatly increased.

A suitable apparatus for carrying out my process is shown in the accompanying drawing, which represents a thorough retort in vertical longitudinal section, and the furnace partly in section.

A through retort *B* is suitably set in the furnace *A* in the usual manner, and the opposite ends of said retort are closed by the tight-fitting lids *b* and *b'*, and one end thereof is provided with a standpipe *D*, connecting at its upper end with the hydraulic main *H*. The outlet end of the retort is also provided with a transverse perforated plate *a* near the standpipe *D*. A steam pipe *C*, having a valve *c*, connects with the opposite end of the retort. A suitable percentage of carbide of calcium, such as 1 per cent. to 5 per cent., is added or mixed with the charge of bituminous coal, preferably before it is introduced into the retort. The charge is placed in the retort, after which the lids are tightly closed and the distillation of the charge proceeded with in the usual manner. At the end of the distillation the lid *b'* is preferably opened and the charge of incandescent coke and residual carbide of calcium is pushed back to the take-off end of the retort and against the perforated plate *a*, as shown in the drawing. The charge of coke is pushed back, so as to fill the entire transverse area of the retort and in the most favorable position for the decomposition of steam. A small stream of steam is now admitted by opening valve *c* and is decomposed in contact with the incandescent coke, producing carbonic oxide and hydrogen. Another portion of the steam will react on the carbide of calcium, thereby liberating acetylene gas. The reactions of the nascent hydrogen and acetylene will produce olefiant gas.



Coals that will ordinarily produce 10,000 feet of 16-candle power gas can be made to produce 15,000 feet of any candle power that may be desired, depending upon the amount of the carbide of calcium used.

I may add to the charge of coal to be distilled as much as 10 per cent. of carbide of calcium, if I desire to produce a rich illuminating gas, such as a 30-candle power gas.

The gas burns with a clear white flame and is very brilliant. The purification and storage of this gas are the same as ordinary coal gas.

No modification of the burner now in use is required in burning the illuminating gas produced by my process.

Having described my invention, what I claim, and desire to secure by Letters Patent, is—

1. The within described process of distilling soft coal with the carbide of calcium and discharging the last traces of illuminating gas by steam.

2. The process of manufacturing gas which consists in mixing with or adding to bituminous coal a suitable percentage of carbide of calcium and distilling the same in a closed chamber to produce olefiant gas.

3. The process of manufacturing gas which consists in mixing with or adding to bituminous coal a suitable percentage of carbide of calcium, distilling the mixture in a closed chamber and at or near the end of the distilling operation passing steam in contact with the charge of incandescent coke and residual carbide of calcium for setting free any remaining acetylene and producing olefiant gas.

Arc Lighting Practice.

By Mr. Alex Dow, in *Electrical Engineering*.

Mr. John Hesketh's comments[1] on arc lighting practice in his country and this are both interesting and valuable. The paragraphs as to lamp supports, globes and carbons deserve the careful study of American electric light men, for it is in these particulars that our practice has been, and still is, susceptible of much improvement.

In the matter of carbons it is not so very long since American 10-ampere lamps, whether for indoor or outdoor use, were uniformly fitted with $\frac{7}{16}$-inch or $\frac{1}{2}$-inch carbons, molded solid and copper coated. Sometimes the lower carbon was not coppered; when the lamp was used for interior lighting this was considered preferable, but neither the use of cored uppers nor of an upper of greater diameter than the lower was admissible. The practice to-day is much better. The introduction of arcs on constant potential systems brought in the imported carbons, with cores of differing diameters; and the alternating arc was a rank failure until a proper carbon and a 30 or 33-volt adjustment were adopted.

1. An English Engineer's Views on Arc Lighting Progress. By John Hesketh, A.M.I.C.E., M.I.E.E., Borough Electrical Engineer, Blackford, England. *Electrical Engineering*, pp. 128-133, No. 38, Vol. VII., February, 1896.
Arc Lighting Progress. By Alex Dow. Electrical Engineer Public Lighting Commission, Detroit, Mich. *Electrical Engineering*, pp. 339-341, No. 36, Vol. VI., December, 1895.

The ½-inch coppered carbon still holds the field in street lighting and is likely to hold it for some time to come. The practice of using partly burned uppers in the lower holders, and double carbon lamps for all night street lighting, are the factors of greatest importance in deciding this, because they require the purchase of but one size of carbon (usually 12 inches long, but ½-inch diameter) and yet allow of every piece of carbon being fairly burned out—the short lengths produced at one season being mated and reissued to the trimmers at another. The worst fault of the ½-inch uniform carbon plan is the tendency to and "lapping" of points during the run; that is to say, the dropping of the upper carbon past the point of the lower, causing a short arc or total extinction. If the current is a trifle high, so that the conical points are longer than normal, or if the carbons are a little crooked, this trouble may become serious. Lamps on towers or other supports much affected by wind or vibration are specially liable to it.

In the plant I operate, analysis of the "outs" for two months showed that lapping was responsible for too much of the total trouble. We were running with $\frac{7}{16}$-inch (11 mm.) carbons in both holders and a large number of lamps were on towers, while still another large number were on poles to which electric street railway span wires were attached. We changed to ⅝-inch (16 mm.) uppers, retaining the $\frac{7}{16}$-inch lowers. Result for four winter month's operation of 1,480 street arcs is just one "out" by lapping. We cannot see any practical difference in the total light. Experiments show a little difference, but it is negligible in comparison with the improved reliability. When one turns from street lighting to interior work, it is seen at once that the day of the uniform carbon is gone. I have only a dozen interior lamps—the incidents of a plant installed primarily for street work; but these dozen use three different carbons, to wit: 13 mm. American made cored uppers with 13 mm. American solid lowers, forced, and not coppered, these being pairs for 45 volts by 9.6 amperes direct-current arcs, and 13 mm. "Electra" cored, for alternating 30 volts by 15 ampere arcs.

It is not unusual nowadays to find a station carrying in stock 10 different carbons for interior work; and the use of uppers of larger diameter than the lowers is frequent, though not yet general. I fear that the refinements found in the best European carbon practice will (like the best of the European arc lamps) never acquire a permanent footing here.

The effort to systematize, which has reduced constant current series arcs throughout the United States to two standard currents, 9.6 and 6.8 amperes, will reduce carbons to a very few sizes and styles. To our central station men life is too short to fuss with lamps of the delicacy of chronometers and with carbons of different sizes for each month in the year.

I notice, however, the differentiation of the street lighting lamp from that rented to private patrons. It is not long, say three years, since the total difference was in the style of the jacket—the street lamp jacket was japanned iron, while the private consumer's lamp was done up in brass. Now the difference is radical. I have already noted it in carbons.

In mechanism the private lamp (if I may so call it) is frequently a shunt wound lamp if run on a series circuit, and often it has a rack feed. The public lamp is usually differentially wound and almost always has a clutch feed. The difference in mechanism extends even to the adjustment of individual lamps, the station lampman cultivating a feed by imperceptible movements for the private lamp, which the said lampman calls a "sneak" feed, while on the public lamp he adjusts for a "drop" feed—that is to say, he tries to have the clutch kick itself entirely clear of the rod at the instant of feeding, causing a *drop* rather than a *slide* of the upper carbon, and the regulating magnet is relied on to immediately adjust the arc to the proper length when the clutch gets its new hold.

There is reason in all the differentiation. The shunt lamp (for the benefit of English readers I explain that a shunt lamp is that in which the separation of the carbons is produced by a spring or weight, while the magnetism due to a shunt winding draws them together, as distinguished from a differential lamp, in which the separation is due to a series coil)—the shunt lamp tends to regulate for constant volts at the arc without regard to the current. This is because the separating force of the spring or weight is constant. It follows that such a lamp will maintain a silent arc, if proper carbons are selected, with a very wide range of current. And so long as the average customer will insist on judging of his light by looking at the arc instead of at the illumination, this quality of the shunt lamp will much reduce the total of the "kicks" received per year. The sneak feed is, of course, the perfect feed, and stops all hissing or flaming.

But consider the street lamp. It is differentially wound because with that winding a decrease of current shortens the arc and so reduces volts as well as amperes. For the normal condition of a dynamo on street-lighting work is full load, and its frequent condition is overload; and it will be remembered that these series dynamos are designed with a drooping characteristic, an increase of current causing a fall of voltage and the maximum voltage for any given speed corresponding to a current less than normal and to instability of point of commutation, so that a small further reduction of current will cause flashing. But with differential lamps in circuit, a reduction of current is at once compensated for by the shortening of the arcs, which reduces the necessary terminal voltage and assists in steadying the machine. It follows that such a dynamo can be operated with differential lamps nearer to its maximum voltage than with shunt lamps.

This gives the central station the equivalent of a reserve of dynamos for use in emergency. Of course, the light will be run with full current under normal conditions, and sufficient reserve for the common accidents of operation must be provided in the shape of spare dynamos. But it is possible, as we did experimentally not long ago, to operate 158 hissing arcs on a 100-light machine without putting any street in darkness, and much more to the satisfaction of the police and the general public than if 100 silent arcs had been maintained and the other 58 extinguished for the rest of the night. Had the lamps been shunt wound, the limit would have been about 110, because each lamp would have insisted on getting full voltage for a silent arc, and that number would have put the dynamo on the top of its characteristic curve and, therefore, to its flashing point.

As regards the drop-feed, the reason is with the lamp. The lampman expects that lamp to stay in service and operate without cleaning or adjustment for at least a year, and if it stays out for two years he is not surprised. It has to stand summer heat when the running temperature of the mechanism is 150° to 160°, and winter cold when the clutch and trips have to start work at 20° below zero of Fahrenheit scale. Also the rods have to be wiped many times by trimmers' cloths, which are not chemically clean, and be handled by trimmers' fingers or mittens, as the season may decide, which said fingers and mittens are sure to be dirty. And that clutch is supposed to grip that rod every time and release it only on the call of the control magnet.

Now the drop adjustment will, with a proper clutch, do its work whether the rod is clean or dirty, wet or dry, worn or new. It will feed a round file correctly, if the file is of the same diameter as the proper rod. You could not get a sliding feed with that file.

The only fault of the drop feed is the momentary hiss, say two seconds, at the time of feed. On the street this is never noticed, though in interior work it would cause a claim for a rebate. And the compensation for this little fault is that the rod gets and needs no care but the daily wipe, and the adjustment needs attention only once a year.

But it is in outward appearance that the differentiation of the private and public lamp is most complete. The latter is still the same substantial, clumsy article, with no pretense to beauty of design or finish. The former is sometimes an artist's dream; and sometimes, alas, a nightmare.

Before quitting the subject of lamps, I venture to predict that the "inclosed arc," having the arc maintained in an inert atmosphere, will be the feature of private lighting for the present year. This is not a novelty, but it seems at last to have got past the experimental stage and to be a practical commercial article of decided value, particularly for interior work.

Mr. Hesketh's statement of his experience with a 60-light (3,000-volt) Ferranti rectifier is of much interest. As noted in my previous paper, the rectifier has a province of usefulness, and the production of a successful 60-light machine enlarges that province, and also causes the hope that the device will soon be perfected in even larger sizes. It will doubtless be introduced in America before long, and our conditions will bring about the 100 and 125-light sizes.

I do not see why, if a commutator on a dynamo shaft delivers 6,250 direct volts smoothly and successfully, a motor-driven commutator should not rectify a corresponding alternating voltage. The constant current transformer can be designed to give the same characteristic as the dynamo, and there is no vital difference between a rectifier and an "open coil" commutator.

As to relative efficiency of the rectifier in Mr. Hesketh's station, compared with the 50-kilowatt direct dynamos here. He gets 73 per cent. I get identically the same. The efficiencies here are distributed as follows:

Say of 1,000 watts indicated power in engine there are expended:

12½	per cent.	= 125	watts	in engine friction.
3	" "	= 26	"	in rope transmission.
14	" "	= 119	"	in dynamo losses.
	Total losses,	270	"	leaving 73 per cent. net output.

Data for these efficiencies were obtained from tests of the various parts. The engine friction is not unreasonably large in a triple vertical engine with 11½, 18 and 29-inch cylinders; 18 inches stroke, and two 7,500 pound fly wheels, at 200 revolutions per minute.

Efficiency of rope transmission was obtained by comparison of pairs of dynamos direct coupled, shaft to shaft, against the same pairs roped together, the one dynamo running as a motor and driving the other. The loss was almost the same at all loads and with different pairs, averaging 1,472 watts—a little less than 3 per cent. of 50 kilowatts.

The dynamo efficiencies were got by several methods: By the Hopkinson method with three dynamos in series; the same, but with a lamp load on the third dynamo; by driving a dynamo by a previously calibrated constant potential motor—*i. e.*, the motor efficiency was obtained by a brake test, and the efficiency so obtained applied to the power absorbed by it when driving the arc dynamo.

I do not question that the rectifier is more efficient than a 55-light Brush set. The dynamo in such a set has to contend with excessive engine losses, and is itself far from being an efficient machine. Its standing in the electrical community is based neither on its efficiency nor its good looks, but on its capacity for hard work and bad usage.

For the conditions of American practice in street lighting, the 100 or 120 light series circuit is a necessity. From where I sit to-night, in hearing of the "sing" of the brushes, the air line distance to lights in each of three directions is 5 miles, the distance by streets about 7 miles. Many single circuits of No. 6 (.162-inch diameter) wire are 25 miles long. If those circuits were operated at 3,000 instead of 5,000 volts, the circuits would be greater not only in number but in total mileage. The C^2R losses on an output of 1,492 arcs and 25 "series" incandescents are nearly 65 kilowatts, say 8½ per cent. They will be about 7 per cent. on the increased output in prospect, as some of the longer circuits in the outer wards will be filled up with lamps. A return to 60-light circuits would mean an enormous increase in the copper; not only for new mains to divide the existing circuits, but for heavier copper to keep down the C^2R loss to an economical figure. When an engineer has to plan a distribution for street lighting over 30 square miles of city, he is glad to use 5,000 or 6,000 volts for transmission, even at some sacrifice of station efficiency; and even when coal is but $2.25 (say 9 shillings) per ton of 2,000 pounds.

As to engine efficiency—a larger engine would be a very little better. In my own case I sacrificed some net engine efficiency by insisting on the simplest possible valve gear, on outboard bearings, and on exceptionally heavy fly wheels; all of these points being to my mind essential to reliable operation. We use on test just 15 pounds water per indicated horse power per hour. In practice we don't do so well; because, of course, there are more or less petty leaks of steam *out*, and of air *in*; and because the auxiliaries (the independent condenser and feed pumps, and the little non-condensing set we run as an exciter for our "side show" of incandescence lighting) are *not* economical. Practice shows 16.8 to 17.2 pounds per horse power per hour of the main engines. We put the heat of the steam from the auxiliaries back into the feed water, and it ends at the coal pile in the consumption of about 2.25 pounds of coal per indicated horse power. The most practical statement of all is that after we have run our trifling day load—some 35 to 50 horse power—and kept the steam pipes warm and the fire pump moving, and banked fires and done all the odd jobs of the 24 hours, we have used about 4.7 pounds of coal per kilowatt hour of output. If we had a day load like the night load we would get that figure down below 4 pounds.

I doubt whether a 500 horse-power engine would be appreciably better in everyday practice, even with the refinements of Corliss gear or balanced valves. I see more possible improvement in properly proportioning the cylinder sizes to the average load than in the refinements of valve gear; for there is nothing more common in American lighting practice than an underloaded Corliss engine, and nothing that can get away with more dollars without the suspicion of the operator. From the rather meager data that reach me by the English technical papers, I suspect that the same trouble afflicts the English stations which use a few large units; and that the superior economy of those equipped with a multitude of Willans engines of small size is due very largely to their never running an underloaded engine. The inherent economy of the Willans engine is a matter of proper cylinder sizes and of minimized temperature range, and the practical economy is in a full load; but you cannot get those ideas into a man who believes in valve gear. He will not believe you so long as the "clickety click" of the trips sings a song of sixpenny saving in clearance and cut-off, though there be a loop like a truelove knot in the card of the cylinder which operates as an annex to the Corliss gear.

But I don't object to trips in their proper place, nor to 500 horse power engines, nor any other size of proper proportion. I selected my own size because I believed four dynamos as many as should be roped to one engine; for the ratio of dynamo troubles requiring a stop of the machine is to engine troubles of similar importance nearly as one to four, with such engines and such dynamos. Then I decided that the economical voltage of the system was 5,000 to 5,500, and assuming the standard current of 9.6 amperes for street lighting arcs, the set of four dynamos figured up to a little over 200 kilowatts. Cylinder sizes were selected to give equal steam economy at full load and at three-quarter load, because in a street lighting plant of four running sets it is always possible to divide the work so as to give each unit at least three-quarter load, and at any load between three-quarter and full the economy will be a trifle better. Shafts and bearings were made amply heavy enough for an overload, if an emergency should ever necessitate it, but one does not expect steam economy on an overload; it does not happen often enough to affect the annual economy, and if it be anticipated it is cheaper to meet it by increased steam pressure than by having the cylinders too large for normal conditions.

This disquisition has run away from arc lighting altogether, yet I trust it will be profitable to some arc lighting man who wonders where his coal goes to, seeing that both engine and boilers are plenty big enough to do their work and as much again. If that man will understand that his extra boiler capacity had better be standing idle, but ready to fire on a moment's notice, and that his big cylinders had better be traded for others of half the piston area to fit the same engine bed and shaft, he will have learned the first and greatest rule of central station economy.

Safety Appliances for Petroleum Tanks.

Dr. R. Kissling, in a recent issue of *Dingler's Polytech. Journal*, remarks that the destruction by fire of the petroleum tank storage at Harburg in May last has directed attention to the subject of petroleum tanks and the danger likely to accrue to the community from their situation in inhabited districts. The report on the Harburg fire, drawn up by M. Albrecht, tended, however, to dissipate the alarm at first occasioned by the catastrophe, by bringing to light the fact that the fire was not due to any specific danger inherent to the use of tanks for storage, but to defective appliances whereby a large volume of an explosive mixture of gas and air was enabled—under the favorable atmospheric conditions, viz., absence of wind, prevailing at the time—to collect above the cover of the tanks, and facilitated—or, at least, did nothing to hinder—the passage of flames ensuing, when the mixture was ignited by lightning into the interior, and so firing the inflammable gaseous mixture existing therein above the surface of the oil.

In considering how similar accidents can be guarded against, three main questions arise, viz.: how can the tanks be protected against ignition: (1) by lighting, (2) by communicated flame from another fire, and (3) how may the danger of explosion be obviated? For the proper understanding and appreciation of the last question it must be recollected that the air space above the oil is filled with a mixture of gaseous hydrocarbons and air, the proportions of which mixture are liable to continual variation from the expulsion of mixed gas and the inflow of air occasioned by the alternate expansion and contraction due to changes of temperature. To return to the protection of tanks from lightning, it is requisite that an efficient installation of conductors must be provided. This can be carried out most suitably by the erection of four rods about 30 feet long, connected at about 16 feet above the lid of the tank by a proper cable of appropriate diameter; this will divert the course of a flash striking between the vertical rods. The system should be grounded to a network of pipes—gas or water pipes—or else to a copper plate of suitable dimensions sunk in the soil water, particular care being taken that all the connections are sound and protected by an efficient covering to shield them from atmospheric and other influences. The rods, cable and ground plate will, of course, require to be capacious enough properly to conduct the electric current to earth, and the periodical examination of the condition of the installation is absolutely essential, especial care being needed to see that the weak points, viz., the connections, are in thorough working order. Measuring the resistance by means of the ordinary apparatus is not sufficient to detect other than large faults in this respect.

In the second point under consideration, the object in view is the prevention of the transference of flame from the external air into the gas space in the tank, and the most efficient method of effecting this is by making the ventilator tubes of a U form, the longer limb projecting through the edge of the tank lid downwards for a few feet, and being provided with three partitions of fine wire gauze—120 meshes to the square centimeter. This downward direction of the tubes will prevent the accumulation of heavy hydrocarbon gases on the cover of the tank. The ventilators will need to be of large diameter to allow ready escape of air during the filling the tank, and may conveniently be enlarged at the points where the partitions are inserted, in order to diminish friction.

The efficiency of this method of protective ventilation has been thoroughly tested on a small scale by the author, who found that the evolved gaseous mixture from petroleum heated in a current of air burned quietly away beyond the gauze interceptors, so long as there was gas to consume, but that notwithstanding the varying proportions of the mixture—from saturation with gas down through the various degrees of inflammability and explosibility to attentuation—no lighting back behind the gauze occurred.

So far as reducing the effects of an explosion to a minimum is concerned, the chief precaution to be adopted is to make the tank cover as light as possible, and provide a liquid seal, glycerine or similar fluid, at its junction with the body, taking care that the cover cannot be carried away by the wind, and that it is in electrical connection with the lightning conductors.

A Hypothetical New Hydraulic Cement.

By Mr. A. D. Elbers, in *Engineering and Mining Journal.*

The term "hydraulic," as applied to mortars and cements, means that such masses continue to harden under water after they have set. Their "setting" may require half an hour, several hours or even a whole day, according to the nature of the compositions, but the hardening under water is apt to continue with all of them for years. Hydraulic mortars are mixtures, the essential constituents of which are lime, siliceous substances on which dissolving lime can react chemically, and water; and hydraulic cements are either natural or artificial compounds of siliceous substances and lime, which have been burned to the sintering point, and which are used without admixture of lime. The setting of hydraulic mortars is due to incipient reactions that take place between dissolving lime and soluble siliceous matter. Though the quantity of the new matter that is formed by such reactions is at first of rather infinitesimal proportions, it is capable of bonding the mass in which it forms. When such masses are allowed to dry completely then they do not become much harder—and sometimes not as hard—as ordinary air mortars. Hence it is said that hydraulic mortars *set* rather indifferently. Hydraulic cements set very energetically, because their particles (or at least a great portion of them) *hydrate* when they come in contact with water. Their setting may in that respect be compared with that of plaster of Paris, but with just this difference: The particles of a mass of plaster of Paris all hydrate inside of a few minutes and increase in volume while they are hydrating; hence, their cohesive attraction becomes partly neutralized by their expansion; the cement particles, on the other hand, do not expand sensibly, and hydrate gradually, not completely at once nor all at the same time; hence it may be said that their mass solidifies actually on account of the cohesive attraction of its hydrating particles. That this action continues, long after the mass has set, is evident from the fact that hydraulic cements take up over three times as much water, within three days after having set, than they combine with while they are setting.

The setting of hydraulic mortars is, therefore, due to influences that are entirely different from those that effect the setting of hydraulic cements. The subsequent induration under water, of either materials, is, however, due to the same—or at least to very similar—influences, as will become more apparent from the following consideration of the chemical behavior of those constituents to the reactions of which the ultimate induration of all such masses has to be ascribed, viz., silica and lime.

Crystalline as well as amorphous silica are entirely insoluble in either cold or hot water; but amorphous silica yields sparingly silicic acid, in aqueous solution, to boiling water that is under strong pressure. This change involves an absorption of heat energy amounting to 11.8 calories (per gram molecule of SiO_2), whereas the heat that becomes latent when water evaporates at 100° C., amounts only to 9.65 calories. Hence it follows, that the pressure of the boiling water must be raised to about 60 lbs. to the square inch before the amorphous silica begins to combine with water, and also, that silicic acid (gelatinous silica) dries quickly when exposed to the air.

Calcium hydrate, on the other hand, dissolves under *evolution* of heat; but as its heat of solution amounts at ordinary temperature (15° C.) only to 3.1 calories, whereas the dissolution of amorphous silica requires a much larger amount, it is evident that dissolving lime can only react on amorphous silica because the resulting compounds supply the difference. There are no current data on the thermal values of such compounds; but the known thermal results of reactions, between dissolved sodium hydrate and silicic acid, and the known reactions between dissolved sodium silicates and calcium hydrate, make it evident that hydrated silicates of lime *can* form when dissolving lime is in contact with amorphous silica, and also, when it is in contact with soluble alkaline silicates. The exact constitution of the silicates of lime that are thus formed in mortars and cements is not known, but it is probable that most of them are at first in a gelatinous state; hence they are apt to lose water—or even to split up into calcium hydrate and amorphous silica, when the mass that contains them dries completely; but when such a mass is under water, then they become gradually crystallized, and the mass is then apt to indurate as long as this process of crystallization goes on. Hydraulic lime (which consists of calcined siliceous limestone), as well as some volcanic earths that make excellent hydraulic mortars, owe their efficiency chiefly to their contents of amorphous silica; other volcanic earths owe their efficiency chiefly to their contents of soluble alkaline silicates, amorphous silica (sand or crystalline silica that has been rendered amorphous by the burning) and (aside from the free lime or unreduced carbonate of Roman cements) lime that becomes free while the cements are hydrating. It is therefore evident that the hardening under water of hydraulic mortars and hydraulic cements is in most cases due to identical influences, as was claimed in the beginning of this article.

There is, however, one peculiar feature of combination that requires especial consideration. It is known that mortars made from lime and certain kinds of blast furnace slag that are readily decomposed by sulphuric acid become as hard under water—within a limited period—as the hydraulic mortars above referred to; they are, however, not so reliable in regard to their ultimate endurance, on account of the soluble sulphides which such slag contains. The kinds referred to are of singulo to sesqui-silicate constitution. They contain so little of alkalies—in some cases mere traces—that dissolving lime cannot be supposed to affect them to any appreciable extent on account of these contents; their efficiency must therefore be accounted for in some other way. It is scarcely necessary to say that the silicates of lime and of alumina of which such slag chiefly consists, cannot even become chemically affected by the heat that is set free by hydrating lime, which amounts to 15 calories per gram-molecule of CaO; but these silicates are also combined with ferrous silicates that change to amorphous silica and ferric hydrate by decomposing water, and this process of decomposition is, of course, accelerated by the heat that is evolved by dissolving lime, and still more by the heat that is evolved by hydrating lime. Moreover, the slag itself is apt to contain appreciable quantities of amorphous silica when it has been granulated (which is always done when it is to be used for the composition of mortars), and for the following reason: As long as the molten slag is in the furnace it is apt to undergo rapid rearrangements, hence some of its silica must be constantly on the move or changing places; and when the flushed slag is cooled suddenly—either by quenching it in water or in any other way—then this silica remains amorphous, because it has not sufficient time to get rid of the heat that it must evolve (viz., 8.1 calories) before it can change to the crystallized state. But this change does set in when the flushed slag is allowed to cool gradually, and as the specific gravity of crystalline silica exceeds that of the amorphous considerably over 10 per cent., it follows that the slowly cooling slag must acquire greater density than the slag that is cooled quickly, which accounts also for the fact that the latter is more easily decomposed by acids than the former. From the foregoing it will become apparent that the indurating capacity of slag mortar depends almost entirely on the amount of gelatinous silica that its slag particles yield to the dissolving lime, that the latter can only react on the slag particles superficially and to the extent to which they expose soluble parts, and that the efficiency of each slag particle is therefore, in a measure, inversely proportional to its size.

The conclusions just arrived at apply not only to slag mortar, but to all hydraulic mortars, and—in a measure—also to all hydraulic cements, including the *new* hydraulic cement, which, as many a reader may have suspected by this time, is to be evolved from blast furnace slag.

It is well known that certain kinds of blast furnace slag, of "sub"

or barely "singuolo," silicate constitution, crumble or fall to powder either in cooling or shortly after they have cooled, that such "slacking cinder" (as it is called by the furnace men) sets, when mixed with water, somewhat in the manner of hydraulic cements, but that it does not set with sufficient force to be available as a cement. As such slag is usually also still more sulphurous than the less basic kinds that have been referred to previously, its use for hydraulic mortar is entirely out of the question; but there is scarcely any doubt that it would set with much more energy if it were desulphurized in the molten state and if it were then cooled rapidly, either by air chilling or by casting it in thin layers on thick plates of wrought iron or low carbon steel.

That slag of this description can be desulphurized in its molten state, and that it can be desulphurized, chilled and ground for less money than it costs to merely provide and manipulate the raw materials for Portland cement, not counting the subsequent burning and the grinding of the burned stock, the writer is convinced of. Taking that point for granted, it remains to be shown why slag that has been subjected to the proposed treatment can be expected to possess inherent hydraulic properties of sufficient merit to come into general use; and as Portland cement is *also* an entirely artificial product, the inferences that can be drawn from its behavior are apt to throw much light on this question.

It is said that the burned stock of Portland cement falls apart or "slacks" when its composition does not contain *enough* of lime, or to put it in another way, when it is too aluminous. Blast furnace slag, on the other hand, is said to slack when it contains *too much* of lime. Hence the fact that slacking Portland stock makes cement of a poor quality does not imply that slacking blast furnace cinder should not make good cement. Then, again, Portland cement "blows" in setting when its composition is too limy. The slacking as well as the blowing can, however, be easily accounted for. In order to convert clay and lime into cement that will have the property of hydrating in the manner hereinbefore described, their mixtures have to be subjected to intense heat.

The hydrating capacity of the resulting compounds depends on a certain state of incipient combination, and in order to bring that state about the mixtures must be heated to a certain temperature, whatever the relative proportion of the respective constituents may be. When the proportion of the lime is small then the progress of combination is apt to be so rapid that a considerable portion of compounds, that have already become sufficiently fritted, are apt to vitrify completely before the intensity of the fire abates. Thus the ferric oxide of already formed calcium ferrate may recombine with the silica of already formed silicates of lime to silicates of iron, which have not the property of hydrating. The slacking of such over-burned masses may, therefore, be solely due to the falling apart of fritted, and of completely vitrified particles, the one kind contracting more in cooling than the other. The particles of slacking cinder, on the other hand, have all been completely melted; hence, their falling apart must be due to the splitting up of compounds that are not stable at ordinary temperature.

Returning to the Portland compositions, it is evident that their over-burning can be prevented by increasing the proportion of the lime, inasmuch as the refractoriness of the mixtures increases with their basicity, always provided that the respective basic constituents are highly refractory. But when there is too much lime, then a portion of it is apt to combine so loosely that it can slake almost as rapidly as calcined lime that is not combined at all, and then the cement "blows." Thus a fritted particle, consisting of $3CaO, SiO_2$, may readily yield one molecule of CaO as soon as it comes in contact with water; in other words, it is to be supposed that the heat that is set free when a molecule of singulo silicate of lime combines, for instance, with one additional molecule of lime ($2CaO, SiO_2 + CaO = 3CaO, SiO_2$), amounts to somewhat less than that which this third molecule of lime sets free by hydrating; but when such sub-silicates have been completely melted—as in the case of blast furnace slag—then they are apt to hydrate gradually, even after they have become split up. It may also be inferred from these illustrations that the sulphides of basic slag must obstruct such possible changes considerably.

The masses, that can form from Portland stock when it is melted completely, are not apt to either slack or split up, because their large contents of easily fusible silicates of iron and silicates of the alkalies would counteract any such tendency; whereas basic blast furnace slag must have that tendency because it is nearly free from combined iron as well as from alkalies.

Finally, it may be mentioned that standard text books on the manufacture of cements contain a good deal of information about the way in which clay and lime are supposed to become changed to silicates and aluminates of lime, about the falling apart of such compounds when in contact with water, about the subsequent recombinations of the respective constituents, etc., much of which the writer has never been able to understand fully. Some of the best authors admit, however, that the compounds, that are formed by the aqueous combination of alumina and lime, are not stable, and that ultimate induration must therefore be ascribed principally to hydrated silicates of lime. Hence, the writer has considered it expedient to simplify the description of the essential changes by leaving the alumina reactions entirely out of the discussion.

There is no doubt that alumina is a very important factor as regards the formation of the *fritted* compouds, of which Portland cement consists; but that does not imply that it is as essential to the behavior of masses that have been produced by complete fusion—such as blast furnace slag—nor that it plays an important part in the aqueous reactions of either product.

SPECIAL ENGLISH CORRESPONDENCE.

COMMUNICATED BY NORTON H. HUMPHRYS.

SALISBURY, ENGLAND, April 10th, 1896.

The Automatic Meter.—Who Should Pay for Alterations of Mains, etc.—Acetylene.—Prof. Crum Brown on the Composition of Coal Gas and Carbureted Water Gas.

That interesting modern appliance which is popularly known as "the penny-in-the slot," and more accurately as the automatic prepayment or the coin-feed meter, has recently figured in the London law courts, in a manner that serves to illustrate some of the risks peculiar to this system of business. In one case a young man was charged with breaking open the money boxes attached to two meters, with wilfully damaging the meters, and with stealing 6s. 6d., the property of the South Metropolitan Gas Company. During investigation of the case, a representative of the Gas Company said that within the last three months 159 of these boxes had been broken open. The prisoner received the exemplary sentence of three months imprisonment with hard labor, the technical term for which, amongst members of his dishonorable profession, is "three months hard." In three other cases the meters themselves were at fault, having supplied gas without first receiving the money, probably by either partial or complete failure of the device for cutting off the supply after the delivery of the pennyworth. It is the custom to require a special signed agreement from the users of the automatic meter, undertaking amongst other things the liability for all gas registered by the meter. If the index shows that 10s. worth of gas has been consumed, and the collector finds only 1s. in the till, the user is called upon to pay up the other 9s. In two cases the Gas Company were awarded the sum claimed, but in the third judgment was reserved for consideration of two points, first, whether the Gas Company had not gone outside of their special Act in making an agreement for supplying by means of the automatic meter, and thus forfeited the protection guaranteed by the same, and, second, whether the Gas Company were not responsible for the proper working of the meter.

These questions have an important bearing on the success or otherwise of this new system, which necessitates considerable outlay in the first place, and also an important increase in the office and working staff. The old plan means one visit per quarter from the index taker, perhaps two from the collector, one bill and one ledger entry. Against this must be put the 13 weekly visits of the collector and a corresponding number of ledger entries. A vital point in the success of the system is a sound and accurate stopping-off device, that will act independently of changes of supply pressure and other varying conditions to which it may be subject. The chief advantage of this method of supplying gas is that it combines the prepayment with the small payment. This point attracts the attention of the sellers, and on the other hand the buyer looks at the fact that he knows what he is paying. There is always something unsatisfactory about buying a thing first and deciding the price afterwards. Nine out of every ten disputed accounts would be settled if it were possible to simply give the consumer three months' notice of the sum that he would in due course be called upon to pay. The introduction of this system carries the obvious conclusion with it that the user's liability is limited to the coins inserted as required from time to time. If he finds that a little surprise is awaiting him at the end of the quarter in the shape of a deficiency bill, the system goes into disrepute at once. People cry out that the last state is worse than the first, and want to go back to the quarterly payment. Some have questioned whether it would not be better to at once accept responsibility for occasional failure, rather than weaken the customer's confidence in the arrangement, or lead him to sarcastically inquire what is to be done

if the meter does not deliver enough gas for the money. The matter is one of those things that cannot be fixed by law, but each case must be settled on its merits. After some experience with an accurate meter, it is impossible for any important deficiency to arise without the same being known. In one of the cases just named there was only fourpence in the till, whilst the consumer had used 3,600 cubic feet of gas. The most ignorant person would be aware, under such circumstances, that he was not paying the full price, and that a claim for shortage would be simply justice to the Gas Company. His plain duty is to advise the sellers immediately any defect is observed, and they would at once replace the faulty machine, and thus the claim for deficiency would be avoided. But if the user knew that no action would be taken when the defect was discovered, he would at least have no inducement to take this course, and the encouragement of dishonesty is a great defect of any system. But the reasons above given for reserving judgment seem to indicate a little of that one-sidedness which the affairs of public companies often receive, even in our law courts. The companies are said to be doing well, or to be capable of taking care of themselves, and therefore a restriction on them, or a concession to the public, takes the place of fair, even-handed justice. Such a policy is as short-sighted as it is unfair, for in the long run it does not benefit the consumer. The proper arrangement respects the rights not of one but of both parties, and it must not be overlooked that, if the Gas Companies have gone outside their Act in connection with any of the details connected with this new plan, they have done so in the consumers' interests and not in their own. They have made a concession to the public by going to a great expense in order to bring an undoubted convenience within the reach of all who require it, and may therefore claim, if anything, a greater amount of consideration than is called for by the ordinary system of supply. Already the first outlay and risk of loss are sufficient to cause many to hesitate about adopting the system. And if to this there must be added an increase in unaccounted-for gas, or any form of loss, the probability is that the prepayment meter, which has sprung into popularity in a most remarkable manner, will be looked upon as a thing that does not pay, and is not worth having. In pointing out these difficulties it is only fair to add that on the whole the prepayment meter is a mechanical success. The makers are to be congratulated on the fact that out of the many thousands in use so few have been heard of in the law courts. With practical experience in working, they will soon be as perfect as anything can possibly be. But it seems to me that the great point is to secure a regular steady consumption per meter, and that unless at least 15,000 cubic feet of gas or so is the average consumption per meter per annum, there is no profit in it. As already remarked, there is a lot of extra expense, and the return for this must come out of the addition to the regular selling price of the gas. This is generally put at 6d. per 1,000 cubic feet, and 15 sixpences are only 7s. 6d.

The question of who is liable for alterations of gas or water mains and services when necessitated by outside influences, such, for instance, as lowering the level of a length of road, is a matter upon which some difference of opinion exists. If the alteration is necessitated by the ordinary affairs of the company, such as the replacing of a pipe with a larger one on account of increased business, no question arises. If the operations of another company, say a railway company, create the necessity for the change, again there is no question as to who should pay for it. If the local authorities, as owners of the roads, are the means of bringing about the alteration, there are some who urge that they also incur the responsibility for all expenses, direct or indirect, connected therewith, whilst others claim that as the roads are the property of the municipality, the main and service pipes are only there by sufferance, and that therefore the owners must remove or alter them when required. Against this it is urged that, in addition to heavy responsibilities in the matter of repair and replacement when the surface of the road is disturbed, the supply pipes are recognized as private property by being assessed on the rating lists, and that therefore they cannot be said to occupy ground on sufferance when they are paying what is in effect a substantial rent for the same. Frequently it happens that the company are glad to have the opportunity of relaying their pipes, and prefer to bear the cost rather than risk any differences with the local authorities. A case in point has lately occurred at Canterbury, where a road was lowered to an extent that necessitated the relaying of the gas and water pipes. The company made a claim for payment of the costs, upon the Town Council, and after some discussion, the same was allowed and ordered to be paid, without entering upon the question of liability.

There is some prospect of calcium carbide being placed upon the English market, as a company has been formed and is about to put down plant for manufacturing it on a large scale. We have plenty of chalk and carbon in the country, but the supply of water power is small and intermittent. So the chief difficulty to be faced will be the source of power, which will influence the cost of the manufactured article. Assuming that a safe and efficient method of generating acetylene as required is available, there are many purposes for which the portability, the power of liberating the gas by a simple process, and the very high quality of the same, will commend themselves at once. Five cubic feet of acetylene will yield a light equal to 24 candles for 10 hours, and a very little over 1 pound weight of carbide will suffice for producing that quantity in practice. This is a great advance on ordinary compressed oil gas, which is 40 or 45-candle power and costs 7s. or 8s. per 1,000 cubic feet at the burner. At anything like a reasonable price, acetylene is the coming agent for lighting tram cars, railway carriages, signal lights and light buoys. The possibility of its entering the field at present filled by coal gas is not yet within hailing distance, but gas companies will not object to have another enricher placed at their disposal. Acetylene will not dissolve naphthaline deposits, but it is a permanent gas within all ordinary limits of temperature and pressure.

The Edinburgh and Leith Gas Commissioners have been considering the desirability of following in the wake of most of our principal towns by adopting carbureted water gas plant as an auxiliary to the ordinary coal gas apparatus, being actuated by the same considerations that obtain in other cases, such as the facility afforded for making a larger quantity of gas without taking additional ground, the adaptability for meeting fluctuations in demand, and the advantage of being able to reduce the coke heap. In making a thorough investigation they have consulted Prof. Crum Brown, of the Edinburgh University, on the chemical part of the subject, and this gentleman has accordingly presented a report on the preparation and use of carbureted water gas. Commencing by explaining the manufacture of pure water gas from steam and carbonaceous fuel, the Professor remarks that in practice, carbonic oxide is more valuable than hydrogen as a fuel, and passes on to deal with carbureted water gas. Although a rich oil gas might be used for conferring illuminating value upon the pure water gas, in practice it is usual to spray the oil into the hot water gas in a vessel called a carburetor, and then to pass the mixture through a superheater, with the result that the ultimate product possesses a composition somewhat different from a simple mixture of oil and water gases. As the result of analyzing four samples of the ordinary coal gas at present supplied in Edinburgh, he arrives at the conclusion that the percentage composition in round numbers is 9 parts illuminants, 11 carbonic oxide, 35 methane, 40 hydrogen, and 5 nitrogen (by difference). The Professor gives the results of some analyses of water gas as made on a commercial scale at a works distinguished as A. To get an idea of the average composition of the crude water gas, three samples were taken from the top of the generator at one, four and seven minutes respectively from the commencement of a run. These show that at first the mixture is practically equal parts of carbonic oxide and hydrogen, but that as the run proceeds, the carbonic oxide is gradually replaced by carbonic acid, with the result that the hydrogen is increased. In the first test there was 47 parts carbonic oxide and 48 of hydrogen. In the third, 15 parts carbonic acid, 25 carbonic oxide and 57 hydrogen, while the second takes a medium position in these respects. On an average analysis, it is expected that the proportion of carbonic acid would not exceed 3 per cent. Some samples of the purified carbureted water gas taken from the top of the last purifier, gave a composition of about 13 per cent. illuminants, 28 carbonic oxide, 17 methane and 35 hydrogen. Two samples of the ordinary supply consisting of a mixture of carbureted water gas and coal gas, showed 7 per cent. illuminants, 11 carbonic oxide, 33 methane and 42 of hydrogen. Similar researches to these were made at another works, called B, where a 21-candle carbureted water gas is made and sent out unmixed. The results of analyzing the crude gas from the top of the generator were rather better than those in the previous case, and a sample of the crude carbureted gas showed 4 per cent. of carbonic acid and 30 of carbonic oxide, while the purified gas contained 12 per cent. illuminants, 32 carbonic oxide, 21 methane and 29 hydrogen. From these and other similar data, the Professor concludes that a mixture of Edinburgh coal gas with water gas in the ratio of 1 to 2 would contain about 10 per cent. illuminants, 18 of carbonic oxide, 30 methane and 36 hydrogen. With regard to the question of safety some interesting data are given. The carbureted gas has, if anything, a stronger smell than coal gas, and when allowed to escape into a room causes annoyance by its offensive odor a long while before it becomes dangerous as a poison, and the conclusion arrived at is that the increased amount of carbonic oxide is no real objection. In addition to this report, some analyses of Edinburgh gas, and also of the gases at "A," are given by Mr. J. Stenhouse, the chemist attached to the Edinburgh gas works.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

MR. T. W. SUMMERS has resigned the position of Superintendent of the Gas Light Company, of Augusta, Ga., to accept a similar place with the Hornell Gas Light Company, of Hornellsville, N. Y. The latter Company is, as before stated by us, now operated by Mr. William T. Morris, of Penn Yan, N. Y., and the naming of Mr. Summers to assume charge at the works' end at Hornellsville is quite a tribute to his capacity, and of Mr. Morris' belief therein; for Mr. Summers was at one time Superintendent at Penn Yan, and changed from there to Augusta, Ga., merely because of the greater salary inducement.

A CORRESPONDENT at Detroit, who is largely interested in the new management of the Windsor (Ont.) Gas Company, writing under date of the 18th inst., has this to say about the proposed extensions this season of the Windsor plant:

"The Walkerville (Ont.) Council has awarded a contract for the public lighting of that place to the Windsor Gas Company, under the terms of which the Company is to maintain 125 gas lamps of the incandescent type. We are making arrangements to pipe the town of Walkerville (our franchise to supply gas there having been obtained some time ago), and as it is a thriving manufacturing center, no doubt we shall reap substantial benefit from our enterprise. During the summer we shall place about 8 miles of mains in Windsor and Walkerville, and we propose to push the business in the named districts as it has never before been pushed. There is a good field to work in, and we propose to do all we can to satisfy the residents that we are able to supply them with a good light at low rates."

THE proprietors of the Staunton (Va.) Gas Company have established the especial rate of $1.50 per 1,000 cubic feet for all gas used for cooking purposes, through separate meter.

AT the annual meeting of the Rome (N. Y.) Gas Light Company the following Directors were elected: J. D. Higgins, H. G. Utley, T. H. Stryker, C. Petrie, W. R. Huntington, T. W. Singleton and J. G. Bissell. The Directors subsequently perfected the following organization: President, T. H. Stryker; Vice President, J. G. Bissell; Secretary and Treasurer, W. R. Huntington.

MR. CHARLES WATSON, Sec. and Treas. of the Camden (N. J.) Gas Light Company, was united in marriage to Miss Annie B. Smith at noon of the 15th inst. The service was celebrated at the home of the bride's parents, No. 328 North Fourth street, Camden.

WE are indebted to Mr. C. H. Nutting, Supt. and Treas. of the Chicopee (Mass.) Gas Company, for the following respecting the Company's practice on and after May 1st:

"On and after May 1, 1896, a reduction in the price of gas will be made. Gas for illumination will be $2.25 per 1,000 cubic feet, with a discount of 50 cents per 1,000 cubic feet, if paid on or before the 10th of the month. Gas for fuel will be $2.25 per 1,000 cubic feet, with a discount of 75 cents per 1,000 cubic feet (provided enough gas shall be used to warrant the setting of special meter), if paid on or before the 10th of the month. Special rates will be made to parties using 60,000 cubic feet or over per year.

"Patrons of the Company are specially requested to notify us of any leaks they may discover, whether from main or service pipes, and also of any unsatisfactory service, and we will give prompt attention to remedying the same.

"Satisfactory gas illumination depends very much upon the condition of distribution pipes and burners, and frequently the quality of the gas is condemned when the difficulty is wholly local, and due to pipes being clogged or of inadequate size, or to the burners.

"While consumers are responsible for the cost and maintenance in good working condition of the burners and the distributing pipes from the meter to the burners, all necessary repairs or changes of the same will be done by the Company at the lowest possible cost of labor and material."

IN our issue for March 23d (p. 454), we illustrated the Hearne device for the safe tapping of mains; and Mr. Hearne now informs us that he has made arrangements with Messrs. William M. Crane & Co., of 838 Broadway, New York, to act as his sole agents for putting the same on the market.

WE had a pleasant chat the other day with Mr. William Christie, the veteran General Superintendent of the Cleveland (Ohio) Gas Light and Coke Company, who has been granted a short vacation by the Company, which he proposes to utilize and enjoy, in company with his estimable wife, by revisiting the place of his birth and childhood in Scotland. He sailed on the Etruria, Saturday, April 18th, and expects to be abroad for six weeks or more. Mr. Christie is indeed a veteran in American gas practice; for, landing in New York in 1848, in the same year he had charge of the small plant which furnished the old Astor House (Broadway, between Barclay and Vesey streets) with gas. May their trip be a pleasant one, and may they both come back to us safe and sound.

SUPT. PRICHARD, of the Portsmouth (O.) Company, is contemplating the construction of a new gasholder, the estimated capacity of which is 100,000 cubic feet. The vessel is really needed to insure the Company's position in respect to the safe supplying of gas to its consumers next winter.

THE certificate incorporating the Metropolitan Gas Company, of Los Angeles, Cal., has been regularly issued.

ACCORDING to the St. Paul (Minn.) *Pioneer Press*, the executive management of the St. Paul Gas Light Company has been completed in the following manner: Directors, Emerson McMillin, Crawford Livingstone, W. R. Merriam, Kenneth Clark and Stanford Newell; President, Emerson McMillin; Vice-President, W. R. Merriam; Secretary and General Manager, B. F. Ellison. A scheme of main extensions of a very comprehensive nature has been agreed upon; and the Company will also, in May, remove to new office quarters.

THE Jenkintown and Cheltenham Gas Company has been incorporated by Messrs. James Ball, W. S. Jamieson, Elmer Smalling, Edwin Hand, Jr., and W. A. McEwen. Jenkintown and Cheltenham are post villages of Montgomery county, Pa., and are about 9 miles north of Philadelphia. Within short distance are the villages of Ashbourne and Shoemakertown. The district is both residential and manufacturing, and could easily afford profitable business for a gas company. The population of the district is not far from 6,500.

WE are indebted to "Observer" for the following clipping from the Boston *Herald*, of the 15th inst.: "Mr. J. A. Blanchard, for the past 27 years an employee of the Boston Gas Light Company, and for many years a foreman in its jobbing department, which latter position he attained by faithful service in more subordinate positions, has expressed his intention of severing his connection with the Company at the close of the month. With a desire that his departure might be made memorable, and in view of his excellent and worthy characteristics, the jobbers' and engineers' departments waited upon him yesterday forenoon and presented him with a handsome mantel clock and a gold chain and charm. The presentation speech was made by Mr. A. N. Farrington, Superintendent of the Street Department, who expressed the high regard in which Mr. Blanchard was held by his associates, and voiced their regret that an association of so many years was about to be severed. The recipient manged to collect his thoughts sufficiently to assure all those present that he was deeply grateful and appreciative, and would forever cherish, as among his most valued possessions, the handsome gifts which they had made."

MANAGER ROSSMAN, of the Keene (N. H.) Gas Light Company, is quite well pleased over the positive signs of satisfaction with which the new gas rate schedule has been received. It took effect on April 1st, and under its provisions all customers who use less than $100 worth of gas in a year are to pay at the rate of $1.90 per 1,000; those using $100 worth to pay at the rate of $1.80. There are 100 gas cookers in use in Keene.

ACCORDING to the last report of Supt. Knowles, of the Richmond (Va.) City Gas Works, the amount of gas sent out last March was 20,850,510 cubic feet, as against an output of 19,839,120 cubic feet in March, 1895.

SUPT. FABEN, of the Toledo (Ohio) Gas Light and Coke Company, has arranged for an addition to the purifying capacity of that plant, which will involve an expenditure of about $10,000.

AT the annual meeting of the Rochester (N. Y.) Gas and Electric Company, the Directors chosen were: J. G. Judson, Wm. Runkle, Frederick Cook, Geo. W. Archer, Walter G. Johnston, R. A. C. Smith, Albert H. Harris, H. G. Runkle, W. E. Stiger, G. A. Hollister, John U. Beckley, H. G. Brewster and G. C. Hollister.

THE proprietors of the Omaha (Neb.) Gas Manufacturing Company have announced a reduction in the selling rate for all purposes to $1.35 per 1,000 cubic feet net. Heretofore the net rate for gas used for illuminating purposes was $1.60, the net rate for a gas supply for cooking, heating and power being $1.35, through separate meters. The concession is to date from April 1st.

AT the annual meeting of the East Albany (N. Y.) Gas Light Company the officers chosen were: President, F. A. Sabbaton; Treasurer, James H. Miller; Secretary, Frank Chamberlain.

SUPT. W. E. POWELL, of the Logansport and Wabash Valley (Ind.) Gas Company, recently sustained severe injuries, through the overturning of a buggy in which he was riding. Our informant adds that Mr. Powell is rapidly recovering.

MANAGER W. M. EATON, of the Jackson (Mich.) National Gas and Fuel Company, is busy overhauling and extending the Company's distributing system.

THE Sisters in charge of St. Mary's Home, Hartford, Conn., are greatly pleased over the operation of the gas cooking range installed recently in the Home by the Goodwin Meter Company. The range is calculated to prepare all the meals to be furnished for 150 people.

THE proprietors of the Corning (N. Y.) Gas Company have authorized their Superintendent (Mr. W. H. Christie) to extend the distributing system by the placing of 2 miles of mains; and he will also keep watchful look over the construction of an additional storage holder, rated to a capacity of 100,000 cubic feet.

A CORRESPONDENT writes: "Under the action of the Decatur (Ills.) City Council, the proposed ordinance fixing the selling rates that may be charged for gas by the Decatur Gas Light and Coke Company are as follows: 1,000 cubic feet and under, per month, $1.50; 1,000 to 5,000 cubic feet, $1.25 per 1,000; 5,000 to 25,000 cubic feet, $1 per 1,000; over 25,000 cubic feet, special rate. A penalty of 10 per cent. may be imposed on consumers who fail to pay their bills by the 15th day of the month following the month in which the gas was used."

THE Light Committee of the Montreal (Canada) Council recently adopted the following resolution: "Seeing that, according to clause 7 of the contract between the city and the Montreal Gas Company, the city has the right to provide for the inspection of gas and meters used by the said Company, and to appoint an inspector to that effect, having the power to examine the quality of the gas furnished by the said Company to the citizens of Montreal, the Committee are of the opinion that such an inspector should be appointed now, and that the duties of such inspection devolve upon Mr. Badger."

ON the 17th inst., notice was given that Messrs. Guillaume N. Ducharme, F. J. Freese, Alex. Walker Ogilvie, Jas. Gross, Wm. P. O'Brien and P. F. Doody, all of Montreal, would apply for papers incorporating the Standard Gas Company, of Montreal. The capital is put at $100,000, and the Provisional Directors named are Messrs. G. N. Ducharme, F. J. Freese, A. W. Ogilvie, James Gross and W. P. O'Brien.

THE general offices of the Denver (Col.) Consolidated Gas Company will be removed, from the present location in the McPhee building, to the corner of 17th and Tremont streets, when the structure now in course of erection at that point is completed.

WE are indebted to a Fitchburg (Mass.) correspondent for the following: "The Committee on Manufactures of the Massachusetts Legislature (Senator Lomasney dissenting) reported a bill in the House, on the petition of Henry M. Whitney for authority to furnish the public with coke and gas. It incorporates H. M. Whitney, H. F. Dimock, Fred. S. Pearson, Jas. Phillips, Jr., Albert F. Parlin and G. B. M. Harvey as the Massachusetts Pipe Line Company, for making, selling and distributing gas for illuminating, heating, cooking, chemical, mechanical and power purposes, and for such other purposes as may be incident thereto under the general laws. The capital stock is $5,000,000, in 50,000 shares, with power to increase, as the Board of Gas and Electric Light Commissioners may approve. It can mortgage property and franchise. No business can be transacted by it till all the capital stock has been subscribed for and 10 per cent. paid in. Power is given to lay pipes in, along, through, under, across or over any public or private ways, lands, water courses, railroads, railways, canals, bridges or subways, provided that in the case of railroads the work shall be under regulations prescribed by the Railroad Commissioners. If a location is wanted in the streets or highways of any city or town, the Company shall petition the Aldermen or Selectmen, and they shall grant that location or such other as they deem proper. If the local authorities refuse, or if the Company is dissatisfied with the location granted, an appeal may be taken to the Board of Gas and Electric Light Commissioners, who, after hearing, shall grant to the Company 'reasonable location.' The ground and property disturbed shall be restored to as good condition as at first. Right to take land by eminent domain is given. Authority to lease or operate the works of other companies is given, but the ruling price shall not be raised. Not over 35 cents per 1,000 cubic feet shall be charged for gas delivered into any holder or to any distributing system. The Company may do business in any city or town in the State; but if the Company wants to enter a place where there is an existing Company, that Company must offer as good terms as the Pipe Line Company, or the application of the Pipe Line Company must be granted. If as good terms are offered the application must be refused; nor shall the price for gas be raised by either Company afterward. Renewed application may be made as often as desired. The rates that may be charged, on a maximum basis, are as follows: For fuel gas in a holder or distributing system, 35 cents per 1,000 cubic feet; for fuel or illuminating gas to individual consumers through other parties, 50 cents; for the same through a leased system, 35 cents, plus the cost of distribution. The sale of electricity for light or power is not permitted. No law relating to candle power is to apply to gas sold for heating, cooking, chemical, mechanical or power purposes. The act is to take effect within six months, upon filing with the State Treasurer a written paper signed by a majority of the incorporators. After building 25 miles of plant the Company shall be secure in its rights till 1917. If it does not build 25 miles in that time the charter shall be void."

THE American Meter Company has been awarded the contract for the construction of a 14-foot station meter for the New Haven (Conn.) Gas Light Company. This meter will be up to a daily registration of 3,000,000 cubic feet.

MESSRS. GEO. H. MORRILL & Co., of Boston, Mass., manufacturers of printers' inks, are erecting a building over some new stills, in addition to their already extensive plant. This building will be of steel construction throughout, having steel sidings, roof trusses and covering, and the interior platforms will be constructed in the same manner. The Berlin Iron Bridge Company, East Berlin, Conn., has the contract for furnishing the complete building.

AT the annual meeting of the Ann Arbor (Mich.) Gas Company, the following result was reached: Directors, E. D. Kinne, S. T. Douglas, H. W. Douglas, William Wagner and Moses Seabolt; President, E. D. Kinne; Secretary, S. T. Douglas; Treasurer, H. W. Douglas.

MR. E. D. STARKE has been appointed Chairman of the Richmond (Va.) Council Committee on Light, vice Mr. Grimes.

MR. J. B. CAHOON, General Manager of the Elmira (N.Y.) Municipal Improvement Company, which concern controls the properties formerly owned by the Elmira Gas and Illuminating Company, has been authorized by the Directors to remodel the generating plant, and a contract for the necessary work in connection therewith has been awarded to Messrs. Jas. R. Floyd & Sons, of the Oregon Iron Works, New York.

IT is officially reported that the Madison City (Wis.) Gas Light and Coke Company, and the Four Lakes Light and Power Company, of the same place (both properties were virtually owned by the same capitalists), have been taken over by the syndicate formed for the purpose by Mr. Emerson McMillin. The officers chosen by the new proprietors are: President, Emerson McMillin; Vice-President, N. B. Van Slyke; Secretary, W. F. Douthirt; Assistant Secretary, John Corscot. Mr. Corscot was Secretary and Treasurer of the Company under its former proprietorship.

THROUGH the courtesy of a correspondent we are enabled to make the following mention of the life of Mr. C. W. Carpenter, Treasurer of the Ilion and Mohawk (N. Y.) Gas and Electric Light Company, who passed away last month. Deceased was born in Deerfield, N. H., July 21, 1819, and first came to Ilion in 1844, where, with the exception of the period between 1857 and 1862, his home was. In 1862 he assumed charge of a department in the shops of the Remington Arms Company, remaining in that employ until 1884. In 1888 he was elected Treasurer of the Ilion and Mohawk Gas Company, in addition to which he acted as President of the Allen Cigar Manufacturing Company, and served as a Director on the Board of the Ilion National Bank. He was President of the village of Ilion for two terms, and was prominent in the church affairs and in the social doings of his community. On Feb. 9th, 1845, he was united in marriage to Miss Lucretia P. Coppernoli, of Mohawk, who survives him, as do a son and two daughters. A notable thing in connection with this history is that his death was the first visitation of the sort in the Carpenter family for 52 years. Interment was made in Armory Hall Cemetery. The services at the residence were conducted by the Rev. Orrin Root, and the ceremonies at the grave were under the direction of Utica Commandery, K.T. Deceased was a staunch Mason, in which order he had attained the 32d degree.

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MONDAY, APRIL 27, 1896.

The Market for Gas Securities.

During the week Consolidated sold up to 164—a record figure for it—but subsequently sold off, on realizing sales. The opening to-day (Friday) was made at 161¼ to 162½. We think the stock is a purchase, although well informed people say there is quite a good chance for the passage by the Assembly of the free lance charter that the New York Carbide and Acetylene Gas Company has already smuggled through the Senate. However, no one need care much about it. All other city shares are strong, even to the point of buoyancy. Brooklyn Union is 88 bid. Chicago gas is 69, and Western, of Milwaukee, is 65 bid. The Directors of the Consumers Gas Company, of Jersey City, have declared a dividend of 2 per cent., which would seemingly put it on a 4 per cent. per annum basis—a cut from 6 per cent. Meanwhile we advise the purchase of the shares, which are said to be offered at 84½, ex. div. We note a sale at auction of 15 shares Yonkers Gas Company at 142. The annual meeting of the U.G.I. Company will be held at the Drexel Building, Phila., on the 4th prox.

Gas Stocks.

Quotations by Cochran & Close, Brokers and Dealers in Gas Stocks.

35 WALL ST., NEW YORK CITY.

APRIL 27.

☞ All communications will receive particular attention.

☞ The following quotations are based on the par value of $100 per share.

N. Y. City Companies.	*Capital.*	*Par.*	*Bid.*	*Asked.*
Consolidated	$35,430,000	100	161¾	162¼
Central	500,000	50	150	..
" Scrip	230,000	..	100	.
Equitable	4,000,000	100	212	..
Bonds, 6's	1,000,000	1,000	105	..
" 1st Con. 5's	2,300,000	1,000	114	.
Metropolitan Bonds	658,000	..	108	112
Mutual	3,500,000	100	233	..
" Bonds	1,500,000	1,000	100	102
Municipal Bonds	750,000	.	..	.
Northern	150,000	50	79	80½
" Bonds	150,000	1,000	..	98
New York and East River	5,000,000	100	88	88¾
Preferred	2,000,000	100	75	..
Bonds 1st 5's	3,500,000	1,000	101¼	101½
" 1st Con. 5's	1,500,000	..	91½	93
Richmond Co., S. I.	348,650	50	50	..
" Bonds	100,000	1,000	..	..
Standard	5,000,000	100	77	79
Preferred	5,000,000	100	107	108½
Bonds, 1st Mortgage, 5's	1,500,000	1,000	108¼	110½
Yonkers	299,650	50	130	
Out-of-Town Companies.				
Brooklyn Union	15,000,000	100	88	88½
" " Bonds (5's)	15,000,000	1,000	105½	106
Bay State	5,000,000	50	23¾	23¼
" Income Bonds	2,000,000	1,000	..	30
Boston United Gas Co.—				
1st Series S. F. Trust	7,000,000	1,000	78	80
2d " " "	3,000,000	1,000	53½	53½
Buffalo Mutual	750,000	100	125	..
" Bonds	200,000	1,000	95	100
Central, San Francisco	2,000,000	..	95	..
Chicago Gas Co.	25,000,000	100	69	69¼
Chicago Gas Lt. & Coke Co. Guaranteed Gold Bonds.	7,650,000	1,000	94	94½
Columbus	1,069,000	..	..	65
1st Mortgage	1,085,000	..	..	96
Consumers, Jersey City	2,000,000	100	..	84x
" Bonds	600,000	1,000	103	104
Cincinnati G. & C. Co.	7,000,000	100	203	204
Consumers, Toronto	1,600,000	50	184½	187
Capital, Sacramento	500,000	50	..	41
Bonds (6's)	150,000	..	..	..
Consolidated, Baltimore	1,000,000	100	64⅝	64⅞
Mortgage, 6's	3,600,000	..	107	107½
Chesapeake, 1st 6's	1,000,000	..	..	..
Equitable, 1st 6's	910,000	..	..	..
Consolidated, 1st 5's	1,490,000	..	..	..
Detroit	4,000,000	..	..	29
" Con. Bonds	4,312,000	..	76	77
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1,000	..	101
Fort Wayne	2,000,000	..	90	95
" Bonds	2,000,000	.	93	96
Hartford	750,000	25		145
Indianapolis	2,000,000	..	137	141
" Bonds, 6's	2,650,000	..	107	108
Jersey City	750,000	20	180	..
Lafayette Gas Co., Ind.	1,000,000	100	93	..
Bonds	1,000,000	1,000	97	99
Louisville	2,570,000	50	.	130
Laclede, St. Louis	7,500,000	100	28⅝	29
Preferred	2,500,000	100	84	86
Bonds	9,084,400	1,000	94	95
Little Falls, N. Y.	50,000	100	..	100
Bonds	25,000	..	..	100
Montreal, Canada	2,000,000	100	200	.
Newark, N. J., Gas Co.	1,000,000	..	93	98
Bonds, 6's	4,000,000	.	123	..
New Haven	1,000,000	25	225	..
Oakland, Cal.	2,000,000	..	46½	..
" Bonds	750,000	..	.	..
Peoples Gas Lt. & Coke Co., Chicago, 1st Mortgage	2,100,000	1,000	..	108
2d "	2,500,000	1,000	104	105
Peoples, Jersey City	500,000	50	..	175
Paterson, N. J.		25	99	102
Rochester Gas & Elec. Co.	2,150,000	50	..	..
Preferred	2,150,000	50	88	..
Consolidated 5's	2,000,000	..	87½	90
San Francisco, Cal.	10,000,000	100	84½	85
St. Paul Gas Light Co.	1,500,000	100	67½	70
1st Mortgage, 6's	650,000	..	84	87
Extension, 6's	600,000	..	..	..
General Mortgage, 5's	2,400,000	.	88	90
Syracuse, N. Y.	500,000	25	..	..
Washington, D. C.	2,000,000	20	250	..
Western, Milwaukee	4,000,000	100	65	67
Bonds, 5's	3,556,000	.	87½	88½
Wilmington, Del.	500,000	5	188	190

Advertisers' Index.

GAS ENGINEERS.

	Page
Jos. R. Thomas, New York City	681
Wm. Henry White, New York City	679
Fred. Bredel, Milwaukee, Wis.	675
H. C. Slaney, Brooklyn, N. Y.	679
Geo. R. Rowland, New York City	679
The Western Gas Construction Co., Fort Wayne, Ind.	670
Humphreys & Glasgow, New York City	666
T. G. Lansden, St. Louis, Mo.	679
American Gas Co., Phila., Pa.	663
David Leavitt Hough, New York City	660

CHEMISTS.

Herman Poole, New York City	661

PROCESSES.

Bartlett, Hayward & Co., Baltimore, Md.	677
United Gas Improvement Co., Phila., Pa.	669
Burdett Loomis, Hartford, Conn.	678
National Gas and Water Co., Chicago, Ills.	671
Economical Gas Apparatus Construct'n Co., Toronto, Ont.	677
The Western Gas Construction Co., Fort Wayne, Ind.	670
A. M. Sutherland, New York City	664

GAS WORKS APPARATUS AND CONSTRUCTION.

James R. Floyd & Sons, New York City	680
Continental Iron Works, Brooklyn, N. Y.	678
Delly & Fowler, Phila., Pa.	680
Kerr Murray Mfg. Co., Fort Wayne, Ind.	676
Stacey Mfg. Co., Cincinnati, Ohio.	679
Bartlett, Hayward & Co., Baltimore, Md.	677
Davis and Farnum Mfg. Co., Waltham, Mass.	676
R. D. Wood & Co., Phila., Pa.	678
Isbell-Porter Company, New York City	678
Fred. Bredel, Milwaukee, Wis.	675
United Gas Improvement Co., Phila., Pa.	669
Berlin Iron Bridge Co., East Berlin, Conn.	666
National Gas and Water Co., Chicago, Ills.	671
Economical Gas Apparatus Construct'n Co., Toronto, Ont.	677
The Western Gas Construction Co., Fort Wayne, Ind.	670
Humphreys & Glasgow, New York City	666
Gas Engineering Co., Pittsburgh, Pa.	676
American Gas Co., Phila., Pa.	663

SCRUBBERS AND CONDENSERS.

G. Shepard Page's Sons, New York City	679
R. D. Wood & Co., Phila., Pa.	678
James R. Floyd & Sons, New York City	680
Continental Iron Works, Brooklyn, N. Y.	678
Gas Engineering Co., Pittsburgh, Pa.	676

REGENERATIVE FURNACES.

Bartlett, Hayward & Co., Baltimore, Md.	677
Fred. Bredel, Milwaukee, Wis.	675
J. H. Gautier & Co., Jersey City, N. J.	675
Parker-Russell Mining and Mfg. Co., St. Louis, Mo.	674
Adam Weber, New York City	674

TAR AND CARBONIC ACID EXTRACTOR.

G. Shepard Page's Sons, New York City	679

AMMONIA CONCENTRATORS.

Michigan Ammonia Works, Detroit, Mich.	660
G. Shepard Page's Sons, New York City	679
Gas Engineering Co., Pittsburgh, Pa.	676

GAS METERS.

John J. Griffin & Co., Phila., Pa.	644
American Meter Co., New York and Philadelphia	683
The Goodwin Meter Co., Phila., Pa.	682
Helme & McIlhenny, Phila., Pa.	683
D. McDonald & Co., Albany, N.Y.	683
Nathaniel Tufts, Boston, Mass.	682
Maryland Meter and Mfg. Co. Baltimore, Md.	682
Metric Metal Co., Erie, Pa.	681
Keystone Meter Co., Royersford, Pa.	682
The Hillen Meter Co., Brooklyn, N. Y.	683

PREPAYMENT METERS.

American Meter Co., New York and Philadelphia	683
John J. Griffin & Co., Phila., Pa.	644
D. McDonald & Co., Albany, N. Y.	683

GAS AND WATER PIPES.

Ohio Pipe Co., Columbus, Ohio	681
M. J. Drummond, New York City	681
R. D. Wood & Co., Phila., Pa.	678
Warren Foundry and Machine Co., New York City	681
Donaldson Iron Co., Emaus, Pa.	681
Addyston Pipe and Steel Co., Cincinnati, O.	681

PIPE CUTTERS.

Wm. Anderson, East Boston, Mass.	681

GAS BAGS.

Peerless Rubber Mfg. Co., New York City	681

STEAM BLOWER FOR BURNING BREEZE.

H. E. Parson, New York City	675

GAS COALS.

Penn Gas Coal Co., Phila., Pa.	673
Perkins & Co., New York City	672
Despard Gas Coal Co., Baltimore, Md.	673
Westmoreland Coal Co., Phila., Pa.	673
Berwind-White Coal Mining Co., New York and Phila.	672
Henry C. Scheel, New York City	673

CANNEL COALS.

Perkins & Co., New York City	672
Henry C. Scheel, New York City	673

GAS ENRICHERS.

Standard Oil Co., New York City	673
The Sun Oil Co., Pittsburgh, Pa.	673
W. H. Townsend, New York City	673

COKE CRUSHER.
C. M. Keller, Columbus, Ind..... 673

CONVEYING MACHINERY.
C. W. Hunt Company, N. Y. City..... 661

GAS GAUGES.
The Bristol Co., Waterbury, Conn..... 661

GAS GOVERNORS.
Connelly Iron Sponge and Governor Co., New York City. 671
Isbell-Porter Co., New York City..... 678
The Wilder Mfg. Co., Phila., Pa..... 661

SELF-SEALING MOUTHPIECE DOORS.
Isbell-Porter Company, New York City 678
Continental Iron Works, Brooklyn, N. Y..... 678
G. Shepard Page's Sons, New York City..... 679

RETORTS AND FIREBRICK.
J. H. Gautier & Co., Jersey City, N. J..... 674
B. Kreischer & Sons, New York City..... 674
Adam Weber, New York City 674
Laclede Firebrick Mfg. Co., St. Louis, Mo..... 674
Cyrus Borgner, Phila., Pa 674
James Gardner, Jr., Pittsburgh, Pa..... 674
Henry Maurer & Son, New York City..... 674
Baltimore Retort and Firebrick Co., Baltimore, Md..... 674
Parker-Russell Mining and Mfg. Co., St. Louis, Mo..... 674
Brooklyn Firebrick Works, Brooklyn, N. Y..... 674

CEMENTS.
C. L. Gerould & Co., Mount Vernon, N. Y..... 674

INCANDESCENT GAS LAMPS.
Welsbach Commercial Co., Phila., Pa..... 668

MICA GOODS.
The Mica Mfg. Co., New York City..... 630

BURNERS.
C. A. Gefrorer, Phila., Pa..... 678

LAVA GAS TIPS.
D. M. Steward Mfg. Co., Chattanooga, Tenn..... 661

GAS TUBING.
Wm. M. Crane & Co., New York City..... 664

PURIFYING MATERIALS.
Connelly Iron Sponge and Governor Co., New York City 671
Greenpoint Chemical Works, Brooklyn, N. Y..... 671
Henry W. Douglas, Ann Arbor, Mich..... 671

EXHAUSTERS.
The P. H. & F. M. Roots Co., Connersville, Ind..... 668
Isbell-Porter Company, New York City..... 678
Connelly Iron Sponge and Governor Co., New York City 671

VALVES.
Ludlow Valve Manufacturing Co., Troy, N. Y..... 670
Chapman Valve Manufacturing Co., Boston, Mass..... 670
R. D. Wood & Co., Phila., Pa..... 678
Continental Iron Works, Brooklyn, N. Y..... 678
The P. H. & F. M. Roots Co., Connersville, Ind..... 668
Isbell-Porter Co., New York City..... 678
The Western Gas Construction Co., Fort Wayne, Ind.... 670

ELECTRICAL APPARATUS.
Wm. Henry White, New York City..... 679

GAS ENGINES.
Otto Gas Engine Works, Phila., Pa..... 684
The American Gas Engine Co., Phila., Pa..... 602
Backus Water Motor Co., Newark, N. J..... 660

ENGINES AND BOILERS.
The Hazelton Boiler Company, New York City..... 661
W. G. & G. Greenfield, East Newark, N. J..... 631

PURIFIER SCREENS.
John Cabot, New York City..... 675

GAS STOVES.
American Meter Co., New York and Philadelphia..... 667
The Goodwin Meter Co., Phila., Pa..... 682
George M. Clark & Co., Chicago, Ills..... 665
Maryland Meter and Manufacturing Co., Baltimore, Md.. 682
William M. Crane & Co., New York City..... 664
Keystone Meter Co., Royersford, Pa..... 682
A. Weiskittel & Son, Baltimore, Md..... 665

CHINA GAS KILNS.
William M. Crane & Co., New York City..... 664

GASHOLDER PAINT.
New York Marine Paint Co., Poughkeepsie, N. Y..... 670

RED CEDAR TANKS.
Williams Mfg. Co., Kalamazoo, Mich..... 660

GASHOLDER TANKS.
J. P. Whittier, Brooklyn, N. Y..... 670

GASHOLDERS.
Bartlett, Hayward & Co., Baltimore, Md..... 677
Continental Iron Works, Brooklyn, N. Y..... 678
Delly & Fowler, Philadelphia, Pa..... 680
Davis & Farnum Mfg. Co., Waltham, Mass..... 676
Kerr Murray Mfg. Co., Fort Wayne, Ind..... 676
Stacey Mfg. Co., Cincinnati, Ohio. 679
R. D. Wood & Co., Philadelphia, Pa..... 678

Stockholders' Meeting.

OFFICE OF THE UNITED GAS IMPROVEMENT CO., DREXEL BUILDING, PHILA., April 22, 1896.

The Annual Meeting of the Stockholders of the United Gas Improvement Company will be held at the Company's Office, Drexel Building, Philadelphia, Monday, May 4th, at 12 o'clock noon, when an election will be held for a President and six (6) Directors to serve for the ensuing year, and such other business transacted as may be brought before the meeting.

The stock transfer books will be closed from 3 P.M., Tuesday, April 28th, until 10 A.M., Tuesday, May 5th.

1090-1 EDWARD C. LEE, Secretary.

WANTED,

A Gas Engineer as Superintendent of Gas Company.

An excellent opening for a young man of good technical education and some experience. Some knowledge of electricity desirable. Address, stating age, experience, references, etc., "PRESIDENT,"

1090-1 Care this Journal.

WANTED,

By a young man of 20 years' experience, a position to take full charge of a medium or small Gas Works, especially where works and business need building up. Coal gas works preferred. A worker and systematic as well as economical manager in all details of the business—manufacturing, construction, mechanical and clerical. Has been successful in pushing the gas stove business for several years. Can furnish competent and unquestionable references. Address

1089-4 "C. A. T.," care this Journal.

POSITION WANTED

By a thoroughly practical man, with 14 years' experience as Manager of works of about 30 millions. Understands mechanical drawing and construction. Address

1089-3 "H. N.," care this Journal.

Position Wanted

As Superintendent of Gas Works.

Has been in the employ of the Passaic (N. J.) Gas Company for the last 10 years as Superintendent, and is a practical mechanic, thoroughly understanding the laying out and erection of plants and the making of coal and water gas. Seventeen years' experience as constructor and builder with John Hanlon, Gas Engineer. Best of references. Address

1086-5 FRANK JONES, Passaic, N. J.

WANTED,

A Second-Hand Wood's Condenser,

Capacity, 50,000 to 75,000 feet per day. Also,

Station Meter, 5 x 5.

State price and condition. Address "A. H.,"

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FOR SALE,

Four Purifying Boxes, 8 ft. by 8 ft.,

with 6-inch Center Valves and Connections, in good order.

HOUSTON GAS LIGHT CO.,

1085-10 Houston, Texas.

Are You Going to the Chattanooga meeting of the Western Gas Association? If so, you will meet a number of progressive Engineers of Coal Gas Works who are alive to the merits of **BEAR CREEK CANNEL COAL.** Find out about it!

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BACKUS GAS ENGINES

GUARANTEED SUPERIOR IN EVERY WAY. BUILT ON HONOR.

Agts. { Chicago Water Motor & Fan Co., 101 Lake St., Chicago. Michell & Co., - - 154 Congress Street, Boston, Mass.

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Send for Catalogue.

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Utilize Your Gas Liquor.

NO EXTRA LABOR OR OPERATING EXPENSES.

Ammonia Concentrator.

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Cylinders and Caissons of PINE or CYPRESS. Any size.

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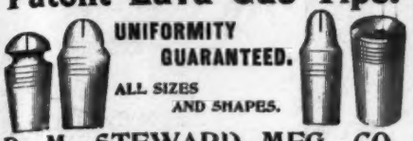
THE GREATEST IMPROVEMENT IN GAS LIGHTING
Has been made by
WILDER'S VOLUMETRIC GOVERNORS.

They control the pressure at the burner, and deliver the quantity for which they are set regardless of high or low pressure in the supply.

WELSBACH LIGHTS are fully controlled, and the governors soon pay for themselves by preventing the breaking of mantles and chimneys. Thousands are already in use. Orders may be given to the Welsbach Co., or sent to ourselves.

THE WILDER MANFG. CO., - 816-822 Cherry St., PHILADELPHIA.

Patent Lava Gas Tips.



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CHATTANOOGA, TENN.

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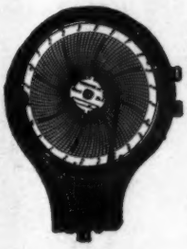


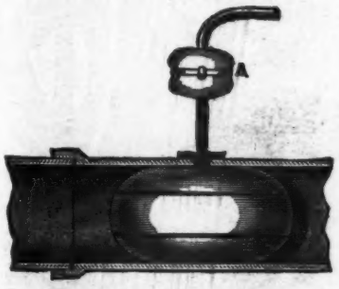
For Continuous Records of
Street Gas Pressure.

Simple in Construction,
Accurate in Operation,
Low in Price,
Fully Guaranteed.
Send for Circulars.

THE BRISTOL CO.
Waterbury, Conn.

Received Medal at World's Columbian Exposition.

Peerless Patent Improved Gas Bag



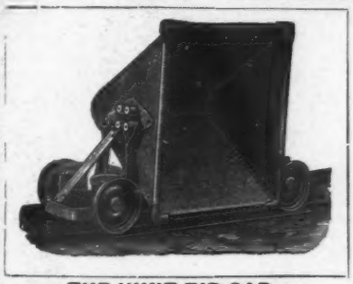
These Gas Bags are used to stop the flow of gas while repairing or making alterations in gas mains. There have been numerous cases of workmen being badly injured, and sometimes fatally, by the escape of gas resulting from the bursting of a bag, and our patent improvement is designed to obviate such calamities. The indicator *A* shows unerringly when the bag has been sufficienty inflated to pack the main, and when the pumping should be stopped. Our Bags are made of a rubber stock especially prepared to admit of great distension, and to resist the action of Oils, Gases, Naphtha and other residuum in the mains, and they are made with lapped joints, which adds greatly to their strength.

3-in.	Gas Bag,	each,	$0.60	12-in.	Gas Bag,	each,	$3.00
4 "	"	"	.80	16 "	"	"	5.25
5 "	"	"	1.05	20 "	"	"	12.00
6 "	"	"	1.75	24 "	"	"	17.00
8 "	"	"	2.65	30 "	"	"	27.50
10 "	"	"	3.75				

The Peerless Rubber Mfg. Co.
16 Warren St., N. Y. City.

HERMAN POOLE * Chemical Engineer,
323 West 34th Street, N. Y. City,
Makes a Specialty of
PURIFICATION
And the Utilization of Waste Products in Gas Manufacture.

C. W. HUNT COMPANY.



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COKE CARS for Gas Works,
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INDUSTRIAL RAILWAYS
Specially designed for handling material in and around
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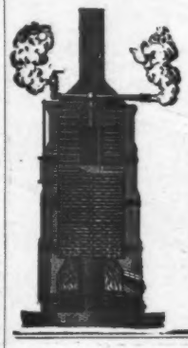
The Pioneer Vertical Water-Tube Boiler of the World!



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After Sixteen Years of Active Service in all the Principal Industries, this Boiler has Proven Itself Superior to all Others in Economy of Fuel, Durability, Safety and General Efficiency.

NO EXPLOSIONS OR ACCIDENTS OF ANY KIND.

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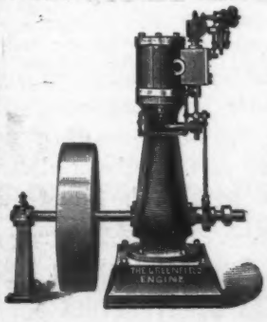

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Established 1874.
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ENGINES AND BOILERS.
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Sizes from 3 to 75 Horse Power.
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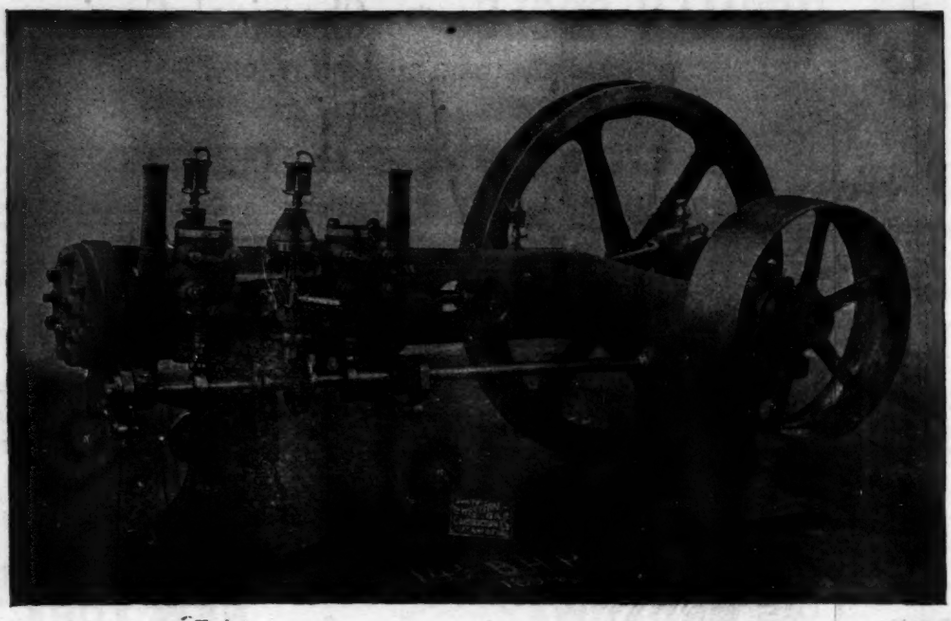
The Double-Acting Gas Engine,

Under the Patents of Griffin, and Dick, Kerr & Co., of London and Kilmarnock.



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Single Cylinder.

Impulse Every Revolution.

(Two Strokes.)

15 to 500 Horse Power.

For General Work and Isolated Electric Plants.

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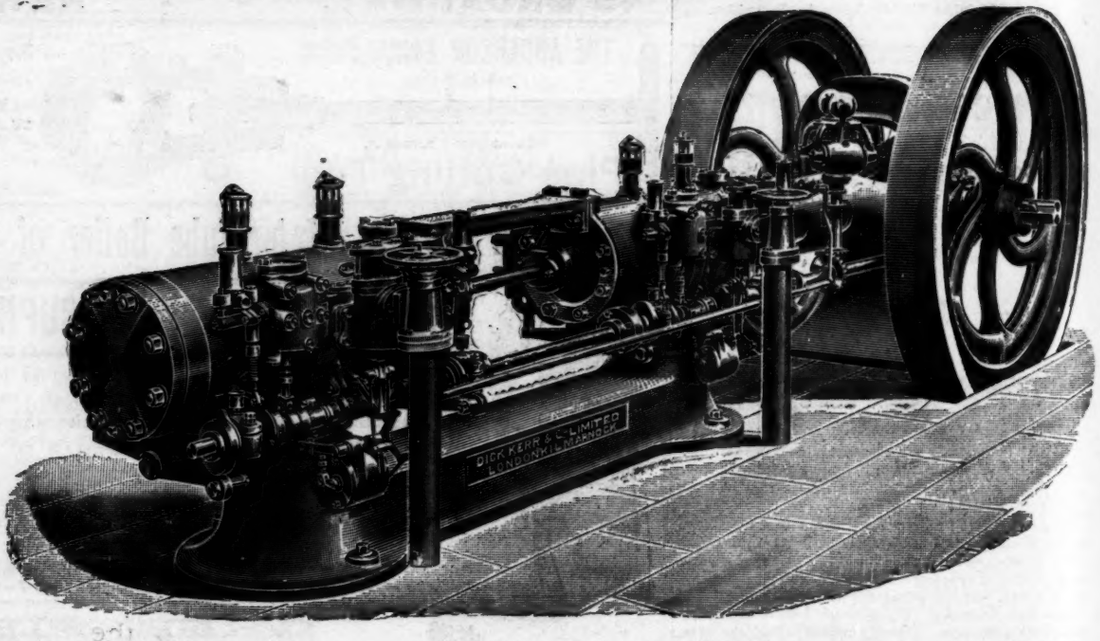
Tandem Cylinder. Impulse Every Stroke. 100 to 1,000 Horse Power.

For Central Stations and all work requiring extreme steadiness.



ESSENTIAL PRINCIPLE.—An impulse at each end of piston; using half force to each impulse; doubling the steadiness; reducing the wear on moving parts, and weight for given power. **CONSTRUCTION.**—The piston rod works through stuffing box in front end of cylinder, and connecting rod is carried in a cross-head working in a slide in frame, as in ordinary steam engine practice. All valves are of the poppet type, operated by cams on a single cam-shaft, giving positive movement to every working part. Tube or electric ignition. **RESULT.**—An engine of extreme simplicity and steadiness of action, the even wear on the cylinder and all working parts assuring increased economy, long life, and minimum cost in repairs. **RECORD.**—Successful and constant use in Great Britain for the past eight years. Address

W. W. GOODWIN, President, Lock Box 718, Philadelphia, Pa., or
THE WESTERN GAS CONSTRUCTION CO. Bldrs. & Gen. Agts. Fort Wayne Ind.

The Improved

Welsbach Light.

No. 34 Burner, with No. 74 Shade.

No. 34 Burner, with Nos. 10 and 43 Shades.

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PHILADELPHIA, PA.

AMERICAN GAS COMPANY,

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Owns, Operates, Buys and Leases Gas Works.

ALSO UNDERTAKES ALL KINDS OF CONSTRUCTION WORK.

Especially the Installation or Extension of Plants for the Manufacture of Gas from Caking Coal.

The attention of Gas Managers is particularly called to the many improvements in this method of manufacture instituted during the past fifteen years, and the extremely low cost at present of Coal Gas.

CORRESPONDENCE RESPECTFULLY SOLICITED. Address

GEO. G. RAMSDELL, Gen'l Mangr.

We Make Everything in the Line of Gas Appliances.

The Vulcan Combination Hot Water Boiler.

Can be Connected with Coal Range or Run Independently by Gas.

The advantages of this Boiler cannot be overestimated.

Economy in consumption of gas, lowest on record.

With the double connection, hot water can be obtained from the use of the coal range or independently by using gas attachment.

Takes up no more room than the ordinary boiler, which it supplants entirely.

There is always complete circulation with the coal range, and also the coil which is heated by the gas

When the gas is used hot water can be drawn *from any part of the house in three or four minutes* after the gas is lighted.

For instantaneous results the consumption of gas is 24 feet per hour. When a continuous supply of hot water is required for the ordinary family use the consumption of gas need not exceed 48 feet per day.

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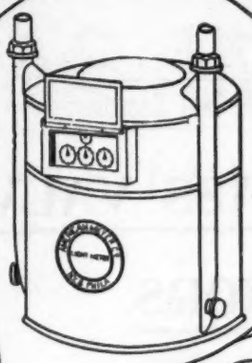

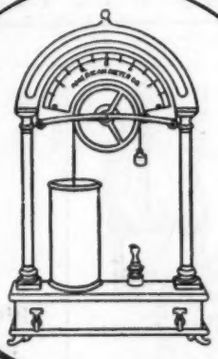

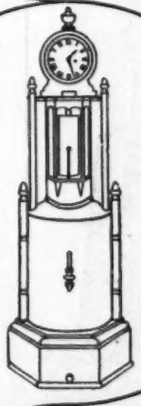

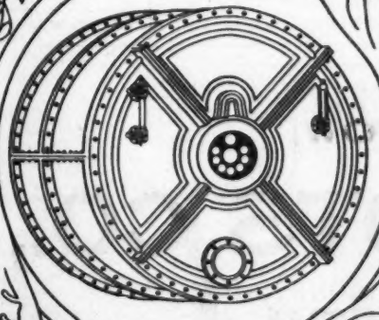

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SAN FRANCISCO.

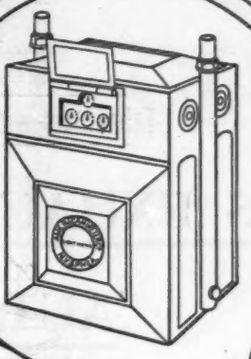
PUBLIC LIGHTING TABLE.

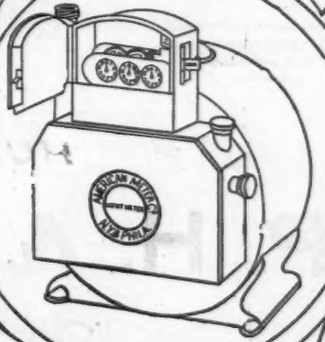
MAY, 1896.

Day of Week.	Date.	Table No. 1. Following the Moon. Light.	Extinguish.	Table No. 2. New York City. All Night Lighting. Light.	Extinguish.
				P.M.	A.M.
Fri.	1	7.20 PM	1.00 AM	6.45	4.00
Sat.	2	7.20	1.40	6.45	4.00
Sun.	3	7.30	2.10	6.45	4.00
Mon.	4	7.30 LQ	2.30	6.45	4.00
Tue.	5	7.30	3.00	6.45	4.00
Wed.	6	7.30	3.20	6.45	4.00
Thu.	7	7.30	3.40	6.55	3.40
Fri.	8	7.30	3.50	6.55	3.40
Sat.	9	7.30	3.50	6.55	3.40
Sun.	10	7.40	3.50	6.55	3.40
Mon.	11	7.40	3.50	6.55	3.40
Tue.	12	7.40 NM	3.50	6.55	3.40
Wed.	13	7.40	3.50	6.55	3.40
Thu.	14	7.40	3.50	7.00	3.30
Fri.	15	7.40	3.50	7.00	3.30
Sat.	16	7.40	3.50	7.00	3.30
Sun.	17	10.50	3.40	7.00	3.30
Mon.	18	11.20	3.40	7.00	3.30
Tue.	19	11.50 FQ	3.40	7.00	3.30
Wed.	20	12.20 AM	3.40	7.00	3.30
Thu.	21	12.40	3.40	7.10	3.15
Fri.	22	1.10	3.40	7.10	3.15
Sat.	23	1.40	3.40	7.10	3.15
Sun.	24	2.10	3.40	7.10	3.15
Mon.	25	No L.	No L.	7.10	3.15
Tue.	26	No L. FM	No L.	7.10	3.15
Wed.	27	No L.	No L.	7.10	3.15
Thu.	28	7.50 PM	10.40 PM	7.15	3.15
Fri.	29	7.50	11.30	7.15	3.15
Sat.	30	7.50	12.10 AM	7.15	3.15
Sun.	31	7.50	12.40	7.15	3.15

TOTAL HOURS LIGHTING DURING 1896.

By Table No. 1.	Hrs. Min.	By Table No. 2.	Hrs. Min.
January	220.40	January	423.20
February	207.00	February	367.40
March	193.00	March	355.35
April	174.10	April	298.50
May	164.00	May	264.50
June	142.10	June	234.25
July	142.10	July	243.45
August	150.50	August	280.25
September	163.00	September	321.15
October	193.10	October	374.30
November	207.00	November	401.40
December	237.30	December	433.45
Total, yr.	2194.40	Total, yr.	4000.00





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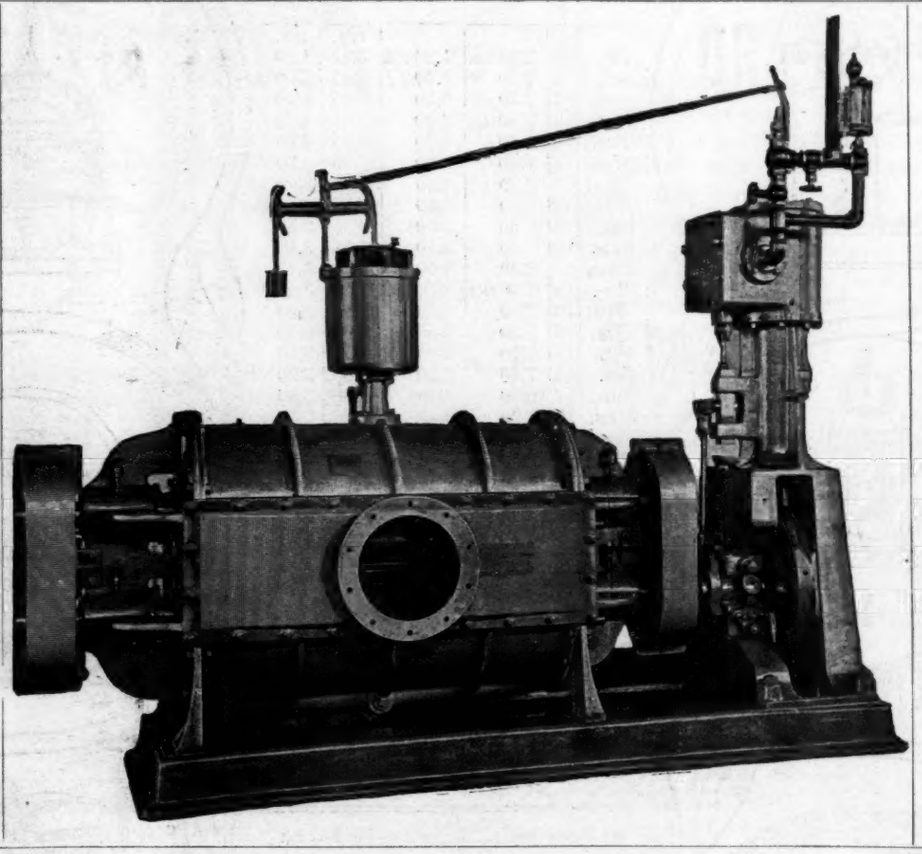

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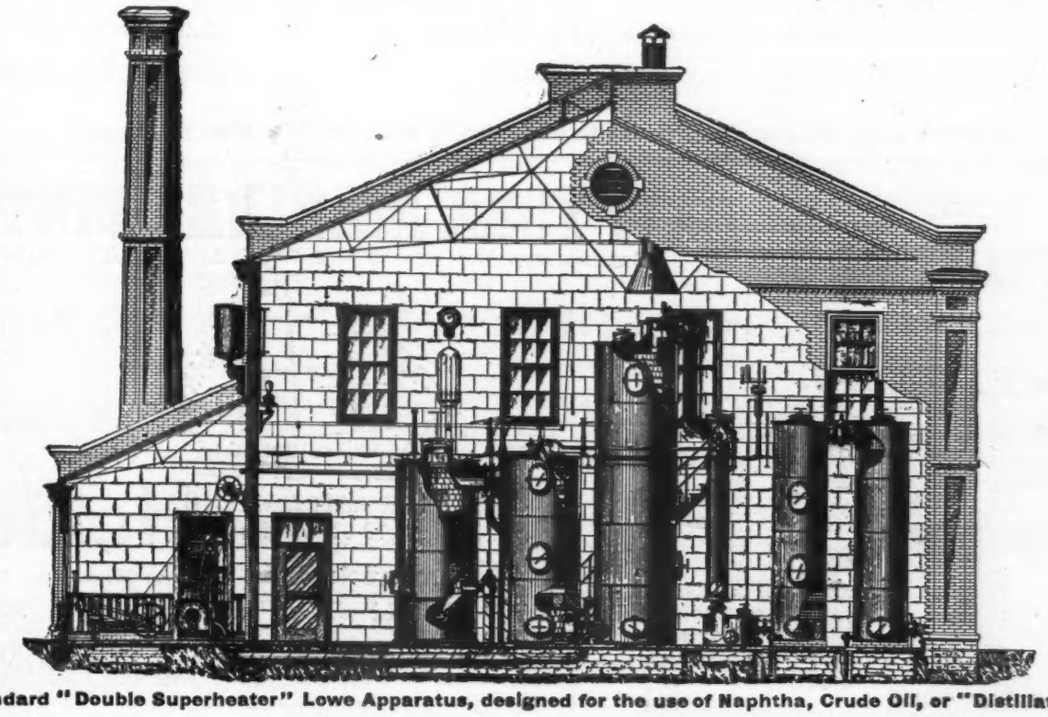

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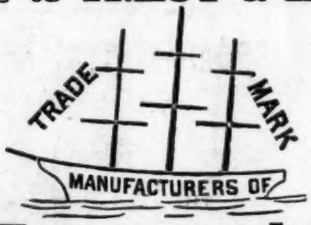

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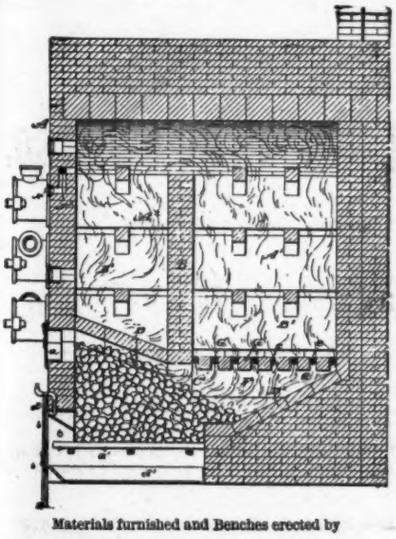

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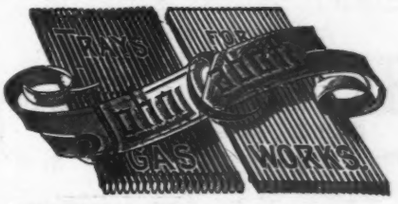

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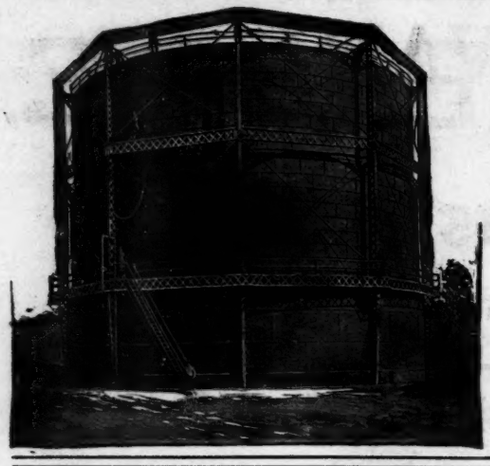

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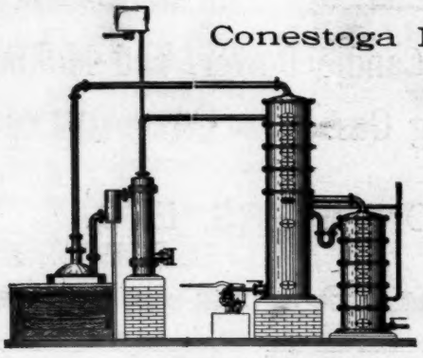

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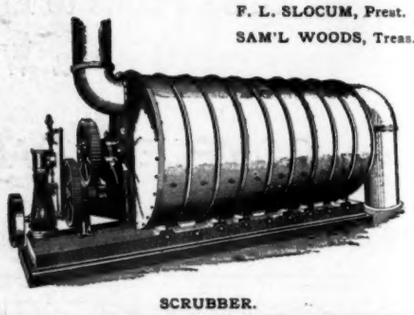

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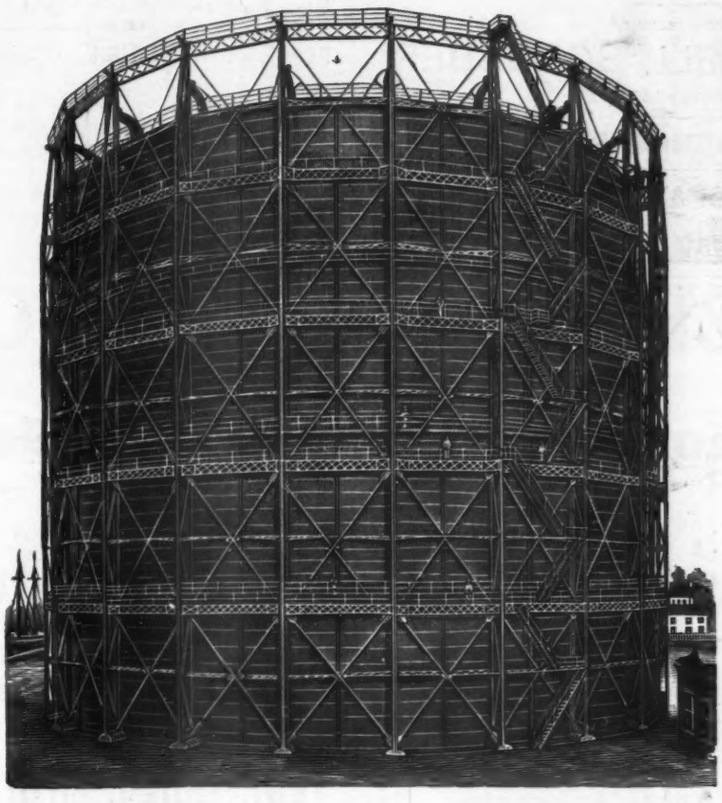

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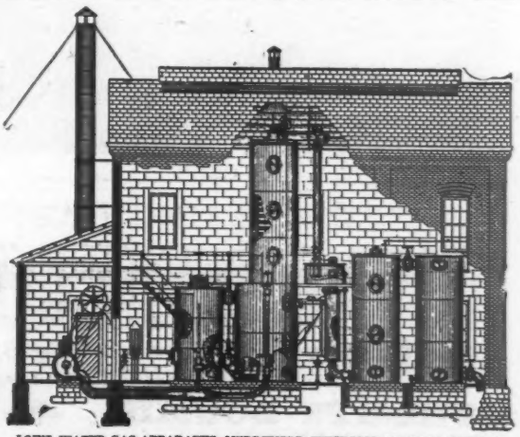

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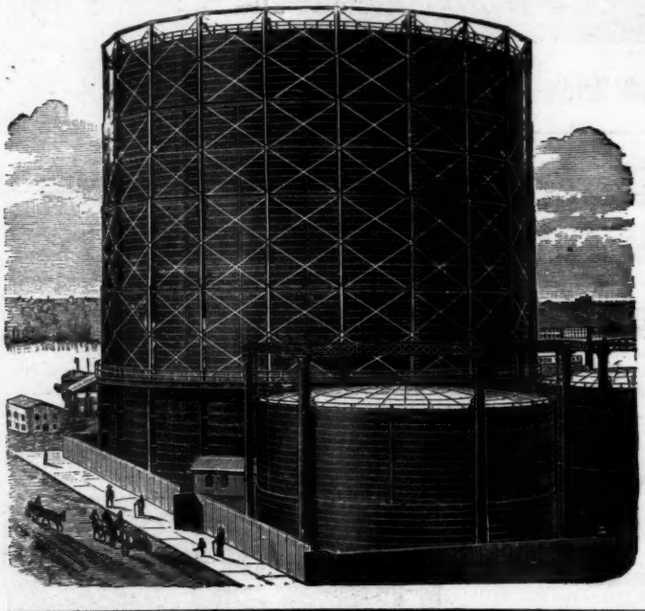

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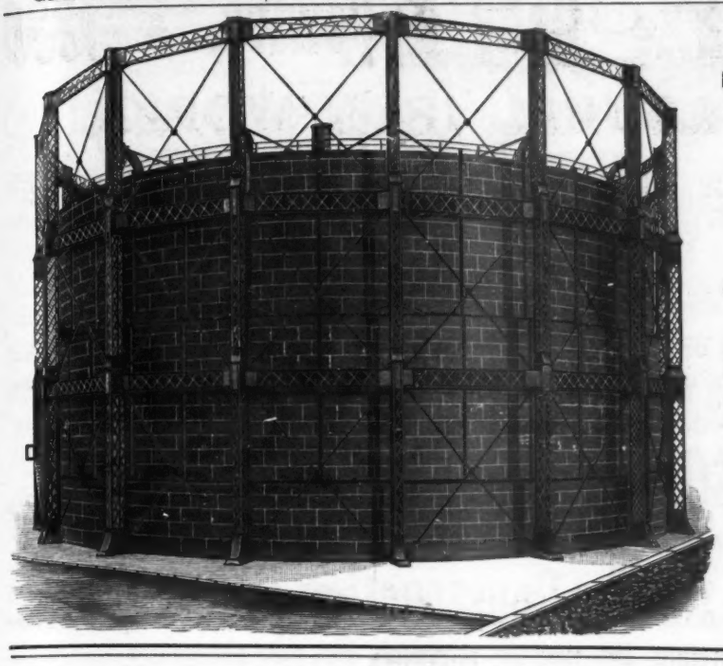

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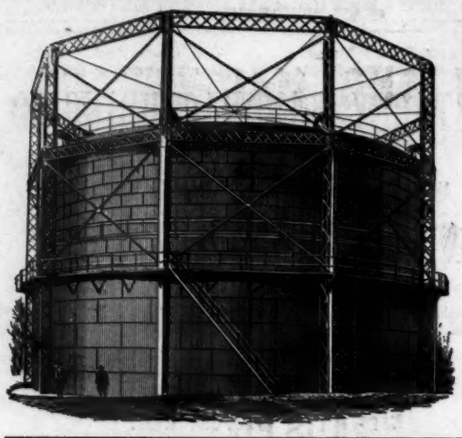

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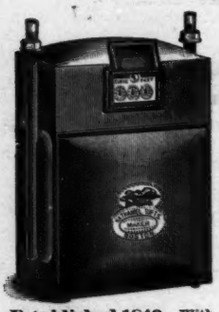

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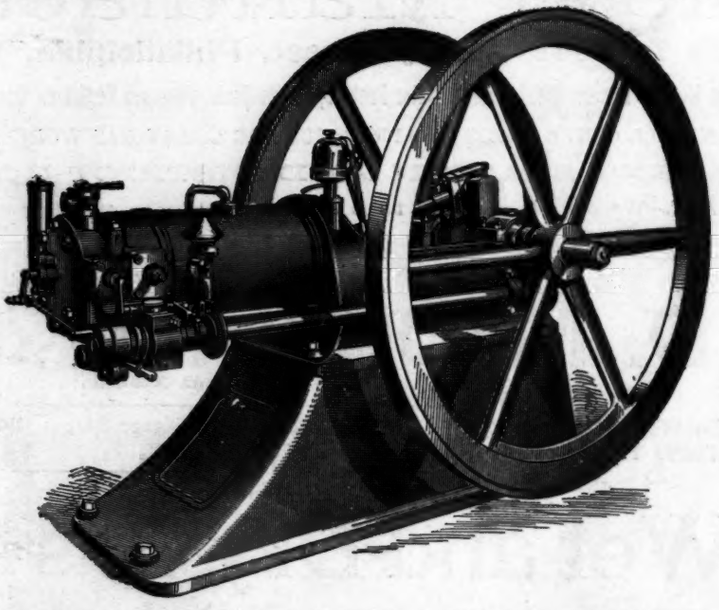

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